Three essays on the economics of fiscal transfers for resource-rich districts in Indonesia

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ABSTRACT

This thesis examines economic aspects of fiscal transfers for resource-rich subnational governments, with quantitative analysis for a large number of districts in Indonesia. Despite the advantages of resource endowment, these districts face a variety of challenges in fiscal management, which intersect with vertical fiscal transfers. There can be difficulties in raising own-source revenue as natural resource revenue may discourage own-source revenue raising. In the expenditure dimension, the presence of environmental spending spillovers can lead to non-optimal environmental spending decision-making by local governments. A further dimension relates to fiscal incentives. The central government attempts to achieve national development objectives through subnational government level by attaching conditions to fiscal transfers, but subnational governments have the opportunity to substitute the assisted expenditures with tied fiscal transfers.

This thesis investigates these challenges through three analytical studies. It contributes to knowledge by providing theoretical and empirical understanding of fiscal policies in resource-rich districts. The findings provide insights to policy makers to further revamp the fiscal transfer design for resource-rich districts.

The first study examines the impact of shared mining revenue on own-source revenue in mineral-producing districts. Using fixed effect method and district level data from 2001–2012, this study finds that the shared mining revenue does not become a disincentive for mobilizing local own-source revenue. The absence of control over mining sector revenue management makes these districts unable to substitute their own-source revenue to mining sector revenue. Nevertheless, the higher poverty rate in mineral-producing districts is negatively correlated with retribution revenue, which contributes to the lower own-source revenue in these districts. Retribution is charges or

fess collected by local governments to community for the use of local government service, including fees for license issuance.

The second study investigates the presence of spatial interaction in environmental spending policy. Using data for all physically neighbouring districts in Sumatera and Kalimantan Island for the period of 2009–2012, the spatial econometric estimations find positive spatial interaction of environmental spending, suggesting a district will increase its own environmental spending in response to neighbours' environmental spending. There appears strong evidence that pollution spillover produced by neighbouring districts serves as the channel of positive spatial interaction.

The third study evaluates the existing fiscal incentive which is earmarked to education spending. Using a difference in difference approach for three periods of analysis, 2009–2010, 2009–2011 and 2009–2012, this study finds strong positive effect of this fund on recipients' education spending. However, the econometric estimations find dissipating increment of education spending over the three periods. This suggests the potential presence of non-additionality fungibility, where recipients reallocate their own budget for education spending in response to regional incentive fund they receive.

Three overall insights emerge from this thesis. Firstly, there needs to establish incentive in fiscal transfer design which drives own-source revenue raising in resource-rich districts. Secondly, there is a case for greater intervention by central government to promote greater environmental spending in resource-rich districts. Thirdly, the ability of the central government to achieve policy objectives through fiscal transfer is hampered by substitutability of funds at local level. This calls for innovative design of fiscal transfer, possibly in the form of output-based fiscal transfers.

1. INTRODUCTION

The natural resource sector plays an important role in the Indonesian economy. The adoption of fiscal decentralization in 2001 changed the pattern of the fiscal system, so that resource-rich districts received a greater share of revenue from their natural resource endowment. However, resource revenue can have a perverse impact on fiscal behaviour (Cevik & Teksoz 2014). This thesis examines economic aspects of fiscal transfers for resource-rich districts in Indonesia, in particular the impact of shared natural resource revenue.

After the fall of the Suharto regime in 1998, Indonesia entered a new stage of its democratic process. In 2001, the Indonesian government adopted fiscal decentralization, where certain fiscal authorities were transferred to local governments. The main purpose of fiscal decentralization was to ensure efficient public service delivery through devolving some fiscal authority held by central government to local governments. The closeness of local governments to their citizens means they understand the characteristics of the region, including culture, environment, endowment of natural resources, and economic and social institutions. This better understanding will enhance the efficiency of public service delivery. From a macro perspective, fiscal decentralization is able to offer greater potential for improved macroeconomic governance and performance (Shah 2007). In order to implement assigned public tasks, such as education, health and environmental services, local governments must enhance their taxing capacity and improve the quality of their expenditure.

1.1 Fiscal transfers and decentralization

The literature in public finance recognizes four components in fiscal decentralization, (1) intergovernmental fiscal transfer, (2) revenue, (3) spending assignment, and (4)

borrowing. Clear functional responsibility among levels of government is considered a crucial step in designing systems of intergovernmental fiscal relations (Vasquez & Qiao 2010). Intergovernmental transfers and revenue assignment to local governments serve to finance expenditure assigned to them to ensure they can deliver efficient public services. Intergovernmental grants are an important tool in fiscal federalism and can have at least three potential roles: (1) the internalization of spillover benefits across jurisdictions, (2) fiscal equalization, and (3) an improved overall tax system (Oates 1999).

Although fiscal decentralization is expected to enhance effectiveness in public service delivery, previous studies raise concerns regarding perverse effects on local governments' public services. Fiscal transfers can become a disincentive for local governments to mobilize resources in their own jurisdictions to finance expenditure. Being analogous with aid, the availability of fiscal transfer can potentially become a disincentive to mobilize domestic revenue through more efficient and effective taxation systems (Bacarreza & Espinoza 2010). When local governments have higher dependency on transfers from central government but lack own-source revenue, the budget constraints will impact public service quality. A previous study has shown mixed results about the impact of fiscal decentralization on citizens' welfare and fiscal outcomes (see Vasquez 2011).

District level governments in Indonesia are allowed to collect certain taxes and retributions which are solely prescribed in the law number 28/2009 concerning local tax and retribution. Nevertheless, unlike provincial governments, dependence on fiscal transfers by district level governments has been persistent since the big bang of decentralization in 2001. In order to increase tax receipts, district level or local

governments are expected to optimize and intensify the prescribed taxes and retributions.

With regard to spending, Law 32/2004 regulates the division of administrative affairs which fall into the responsibility of local governments and central government. Indonesia's central government is only responsible for the judicial system, religious affairs, national defence and security, fiscal and monetary affairs, and international diplomatic relationships. Other than those five duties plus macroeconomic planning and standardization, all government duties must be handled by local governments, especially at district and municipal level. Law 32/2004 also regulates the list of government services that fall under the responsibility of local governments, including public works, health, education, trade and industry, investment, control of environmental impacts, agriculture, cooperatives, and labour. Despite the divided responsibility of the spending area, a lack of own-source revenue would obviously affect spending quality, leading to greater reliance on fiscal dependence. Hence, fiscal constraints can see local governments encounter difficulties in developing strategic policies, including environmental protection programs.

Due to limited budget and revenue sources, spending choices become an important issue for local governments. A previous study (Keen & Marchand 1997) argues that fiscal competition between districts may lead to systematic inefficiencies in the composition of public expenditure and may put downward pressure on welfare spending. Another factor which can affect spending levels is the presence of spending externalities. For example, the provision of environmental services involves spatial externalities where the costs of provision are borne by a jurisdiction, but the benefits are realized on a larger scale, thus giving rise to interdependence among regions' fiscal policies. The mismatch between decision-making responsibilities and costs and

benefits has been considered a cause of under-provision of services (Kumar & Managi 2009).

Another dimension relating to fiscal decentralization is the provision of intergovernmental fiscal transfers aimed to support local governments' financing for public services. Three types of intergovernmental transfers serving as balancing funds are stated in Law 33/2004: (i) revenue sharing, (ii) general allocation fund, and (iii) specific allocation fund. Revenue sharing could be further classified into natural resources revenue sharing and tax-revenue sharing. Four natural resource commodities are shared between central and local governments: oil and gas, general mining, forestry, and fisheries. Among local governments, revenue is shared among provincial governments, producing district/municipal governments, and other district/municipal governments within a province. The general allocation fund or *Dana Alokasi Umum* (DAU) is the most important and significant revenue source for many local governments. The revenue sharing and DAU are classified as general purpose transfers; on the other hand, the specific allocation fund falls into conditional or earmarked transfers. This particularly aims to help local governments to perform central government's priorities in certain sectors. Table 1-1 below shows the development of fiscal transfers for fiscal balance purposes. DAU is the most important fiscal transfer and dominates more than 60% of total transfers, with an upward trend.

Table 1-1 **The composition of fiscal transfers (in trillion IDR)**

Type of transfer	2008	2009	2010	2011	2012
Shared tax revenue	38	41	46	41	47
Shared natural resource revenue	41	36	45	54	62
General allocation fund (DAU)	180	186	204	225	274
Specific allocation fund (DAK)	21	25	21	25	26

Source: Audited transfer report for various years
Note: The figures include transfer to provinces. IDR represents Indonesian rupiah, where 1 US$ was around 12.000 IDR on average.

1.2 Natural resource revenue

Compared to shared tax revenue, the composition of shared natural resource revenue is greater, but was lower in 2009 as a result of the oil price decline as shown in Table 1-1. The Indonesian Crude Price (ICP) was US$61 per barrel in 2009, which is much lower than in 2008 when it was US$101.4 per barrel. The drop in shared natural resource revenue suggests Indonesia's vulnerability to global commodity prices.

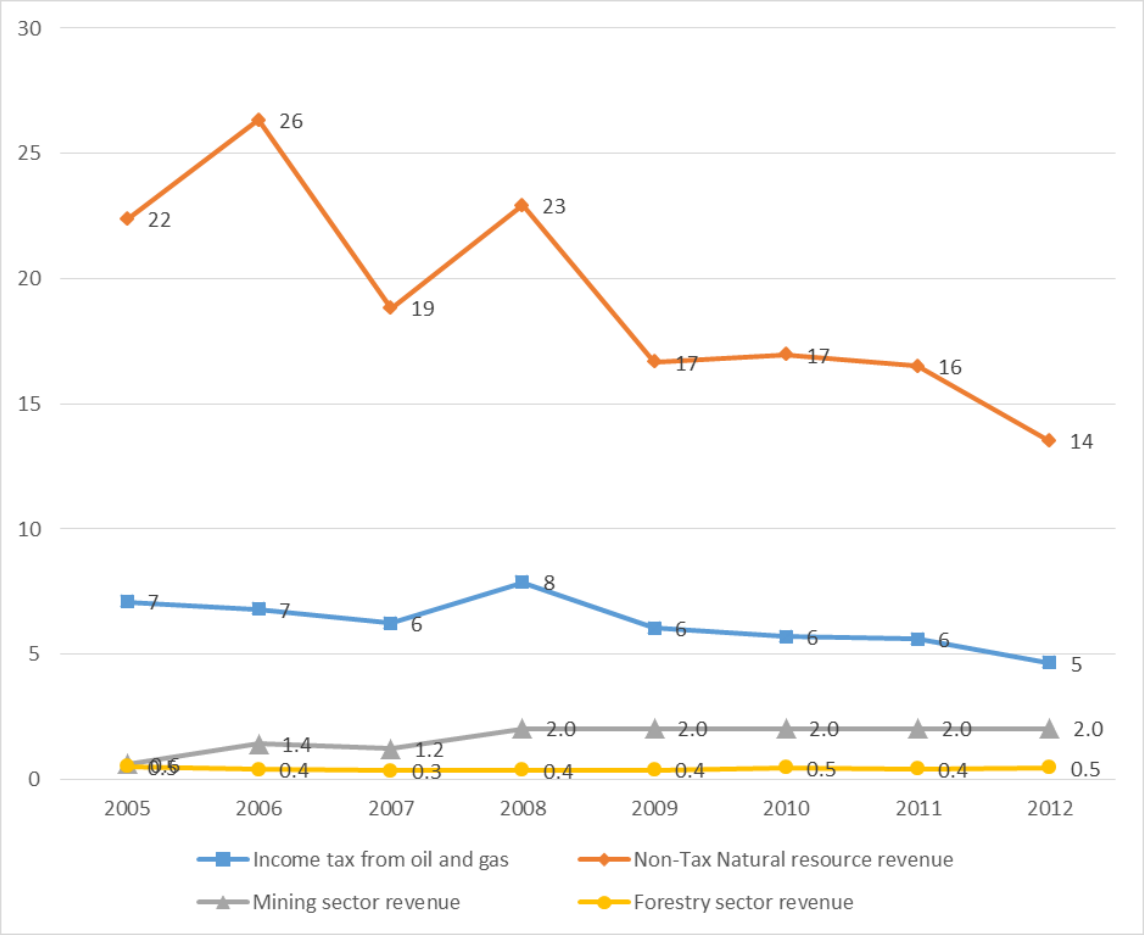
The natural resource sector plays a crucial role in the Indonesian economy, accounting for a significant portion of central government revenue composition. Before 2009, total average natural resource revenue accounted for around 30% of total national receipts. In 2006, the natural resource sector contributed almost 33 per cent of total national revenue; however this figure declined to 18 per cent in 2012. There two sources of natural resource revenue in the revenue composition of the Indonesian government are (1) non-tax revenue, which includes royalties and fees, and (2) taxes on the natural resource revenue sector, which includes income tax on oil and gas companies.

Figure 1-1 shows the size and trend of natural resource revenue composition in the national government budget. Although non-tax natural resource revenue contributes a greater portion of the total government budget, it has fluctuated and declined since 2009. This is mostly explained by the lower oil price and declining oil drilling. Non-tax

natural resource revenue, which excludes income tax from oil and gas, shows a significant downward trend, from 22% in 2005 to only 14% in 2012 (MoF 2012).

Similarly, government revenue from income tax from the natural resource sector also fluctuated and showed a declining trend. This is income tax collected from the oil and gas sector. In 2005, income tax from this sector contributed to around 7 percent of total central government revenue, but it declined to only 5 percent in 2012. Despite the decline in revenue from oil and gas, mining sector revenue shows a slight upward trend from 2005 to 2012. Interestingly, forest sector revenue was relatively stable during this period. This boom and bust in revenue suggests the vulnerability of the Indonesian economy to world commodity prices, and suggests the Indonesian government needs to diversify its revenue sources from natural sectors to non-natural resource sectors.

Figure 1-1 **The composition of the natural resource revenue sector in national revenue**

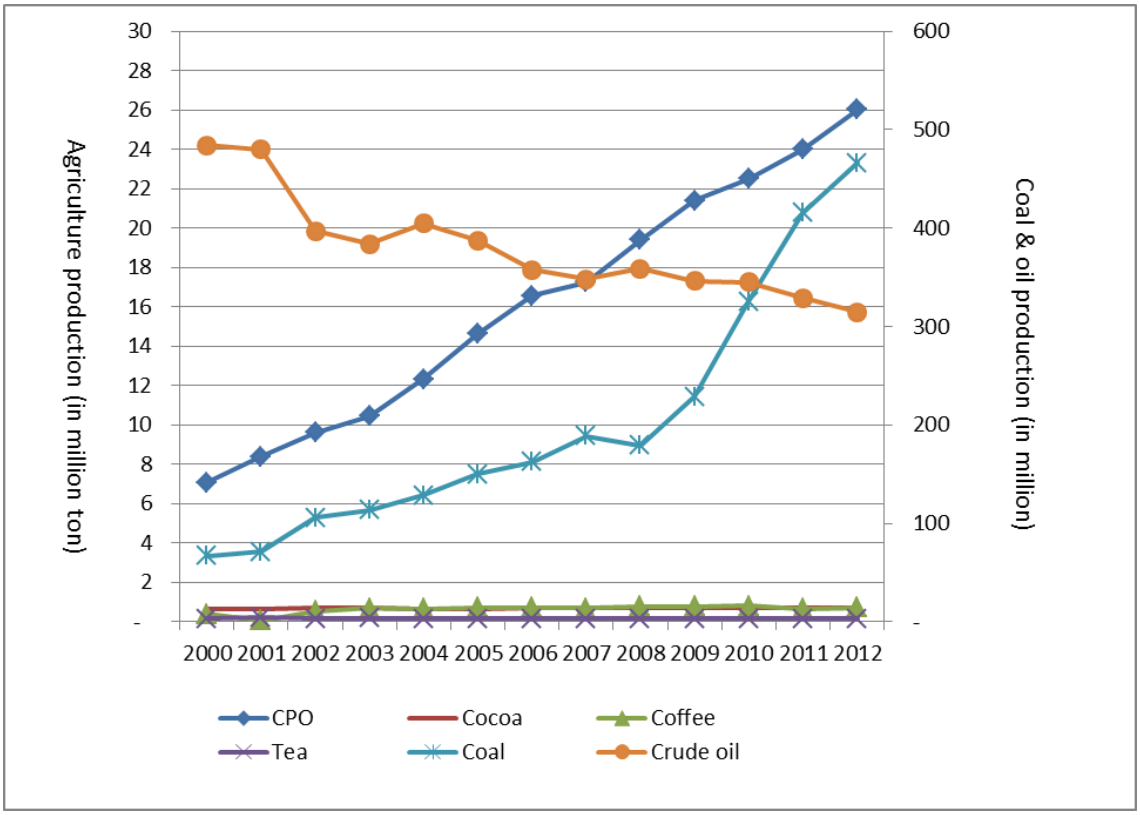


Source: Annual budget note-various years (Ministry of Finance)

Figure 1-2 below shows the development of coal and crude oil production and the production of crude palm oil (CPO) and other selected agriculture products. CPO plantation and coal mining are two sectors which bring risk with forest clearing for new investment or expansion. Over the period of 2000–2012, CPO and coal show an upward trend, in particular coal production. Since 2001, when decentralization commenced, coal production has jumped significantly. However, crude oil production shows a significant decline from around 480 million barrels in 2000 to only 314 million barrels in 2012. The production of CPO increased almost fourfold within 12 years, from 5 million tons in 2010, and jumped to 26 million tons in 2012. In contrast, the production of other

agricultural products was stagnant or not drastically altered. These facts show that palm oil is a preferred commodity, although it often claims forests for expansion.

Figure 1-2 **The development of the production of selected agricultural products and the mining sector (oil and coal)**



Source: Indonesia statistics office online database.
Note: The unit of measurement for coal is millions of tons, and millions of barrels for crude oil.

1.3 Environmental policy and management

While Indonesia is richly endowed with natural resources, environmental degradation is continuing at an alarming rate. The International Energy Agency (2011) estimates Indonesia's carbon emissions from fossil fuel combustion amounted to 376 million tonnes of CO_2 in 2009, ranked 16th among world carbon emitters. As a forest rich country, degradation in the forestry sector dominates carbon emissions in Indonesia. About 75 per cent of carbon dioxide emissions came from deforestation, followed by energy sector (PEACE 2007). The World Bank (2009) reports that air pollution costs the Indonesian economy approximately $400 million per year.

Along with fiscal policy devolution, environmental policy decentralization also accompanied the democratic process in Indonesia. The motivation for this policy is that local governments have more information about their jurisdiction, so they will be able to address environmental problems, and provide better environmental services at the local level and better management of the natural resource sector. The fiscal decentralization introduced in 2001 brought the involvement of local governments in forest management in Indonesia (Barr et al. 2006). It is expected that forest decentralization will bring benefits such as better forest conservation as local governments can closely monitor forestry issues in their region. A previous study suggests that decentralization in forest management will result in more cost-effective forest conservation (Somanathan et al. 2009).

Although environmental policy decentralization can bring benefits, Sigman (2014) shows that devolution of environmental management authority to local governments not only presents greater hope for better environmental conservation but may also lead to detrimental effects on environmental sustainability. At times, decentralization has motivated fiscal competition among local governments for capital, leading to what is called a 'race to the bottom' (Konisky 2007), where less stringent environmental regulations are used to attract mobile capital. Farzanegan and Mennel (2012) find that fiscal decentralization leads to higher pollution in their cross-country estimation.

Despite being an archipelagic country, almost 52 per cent of land in Indonesia is forest cover. Forest is not only an important source of living for local communities, but forests are home to many important sectors. Forest is more than just trees; it is also home for many industries, including mining. Mining sites in forestry areas cover more than 15 million hectares (Mha) or around 15% of total forest size (FWI 2010). Although mining contributes an important portion of national revenue, it unfortunately contributes toward

environmental devastation. Abood et al. (2014) find that oil palm plantation, logging, fibre plantation (pulp and paper), and coal mining concessions accounted for 44.7% (6.6 Mha) of forest loss in Kalimantan, Sumatera, Papua, Sulawesi, and the Moluccas between 2000 and 2010. Illegal mining and illegal logging have plagued this sector and led to massive devastation. The impact of forest loss is more than just biodiversity loss, with the issue of haze pollution from forest fires sparking both economic and health concerns.

From the forest conservation perspective, previous studies present different results and arguments. Curran et al. (2004) finds, during the 1985–2001 period, that 56 per cent of lost forest cover in west Kalimantan was attributed to forestry decentralization reform. This decentralization reform allowed local governments to issue small logging parcels that caused '*uncontrolled harvest of remaining accessible lowlands*'. Another plausible argument to explain the failure of forest decentralization is that good governance is lacking in many tropical forest countries. Structural constraints, including corruption and a lack of accountability, may have hampered improvements in governance and it is difficult to see forest decentralization working ideally (Tacconi 2007).

Another environmental challenge facing Indonesia in promoting sustainable growth is the high and frequent incidence of forest fire. Forest fires can result from natural factors, such as high heat intensity in dry areas and El Niño, and human induced factors. The human induced forest fire is a planned activity which is driven by economic motives and this is the main cause in Indonesia (World Bank 2001). As a major world CPO producer, the incidence of forest fire in palm oil plantations has been a hot domestic issue, in particular in Sumatera and Kalimantan. The incidence of forest fires not only harms forest cover, but also leads to worsening global climate change.

1.4 The challenges in environmental policies at local level

As a country reliant on natural resources and one of the main contributors to global gas emissions, Indonesia is vulnerable to the impact of environmental degradation. Amidst global concern about the impact of climate change, Indonesia plays a significant role in global emissions. As a part of national action, the Ministry of Finance (2009) published a Green Paper which suggests a broad range of fiscal policies to address carbon emission abatement, including the introduction of fiscal incentives for local governments.

In response to the global climate change issue, the Indonesian government has committed to reducing emissions to 26% relative to business as usual (BAU) in 2020 and to an additional 15% reduction in carbon emissions with international support. Given its role in Asia and the global economy, Indonesia's reduced emissions can significantly contribute toward lower greenhouse gas emissions and potentially make the country a role model for other developing countries in tackling global climate issues (Jotzo 2012). Robust environmental policies are crucial to ensure the Indonesian government is able to achieve expected emission reductions. Despite the decentralized environmental policies, the current environmental problems do suggest the need to further investigate the implementation of local governments' environmental policies. In addition, this reveals the need for innovative fiscal policies which can induce stronger commitment from local governments' toward environmental conservation.

The environmental problems in mineral-producing districts in Indonesia have emphasized the importance of research about how natural resource endowments influence local governments' fiscal behaviour. By understanding this linkage, central government can determine the right fiscal transfer policies to encourage local governments' involvement in environmental management issues. Studies aiming to

investigate this issue at the local level in Indonesia are still limited. On the policy making side, the narrow aspect of the findings of this research will help provide insights to policy makers on environmental issues and fiscal transfer design in Indonesia. In the broader aspect, this research can contribute to the literature on environmental fiscal transfer. This background forms the basic argument about the importance of this research.

1.5 Research and analysis in this thesis

Given the broad range of environmental conservation issues, this research focuses on three dimensions of fiscal and environmental decentralization. Specifically, this research aims to study the dynamics of fiscal transfer and environmental issues in Indonesia through revenue and spending, and fiscal transfer design. In particular it will examine how natural resource endowment links with local governments' fiscal performance, own revenue and spending. In particular, it will consider which transfer model can increase the effectiveness of fiscal transfers. In regard to the research purpose, this thesis has three research questions: (i) does shared-resource revenue affect own-source revenue efforts, (ii) is environmental spending inter-correlated among districts? (iii) Which fiscal transfer system can help achieve desirable outcomes in resource-rich districts?

Three analytical studies are undertaken to answer the questions in this thesis. The first study in the thesis attempts to examine the impact of shared natural resource revenue over local governments' own-source revenue, in particular in resource-rich districts. In 2012, of 479 districts, 302 districts or 63% were classified as mineral-producing districts. Shared natural resource revenue was dominated by districts in Sumatera and Kalimantan Island. The shared-mining revenue has become an important source of revenue and contributes the greatest portion of total shared natural resource revenue.

Despite greater shared-mining revenue, own-source revenue in mineral-producing districts in Indonesia is lower than in non-mineral producing districts. Given the limited financing capacity of the central government, high reliance on fiscal transfers can weaken public service delivery, in particular the impact of natural resource exploitation. Hence it is important to investigate whether shared-mining revenue becomes a disincentive for own-source revenue raising in mineral-producing districts.

This study uses a newly constructed revenue dataset of 479 districts in Indonesia, with a focus on 302 mineral-producing districts for the period of 2001–2012. The theory of the natural resource revenue sharing system is used to develop the argument in this study. A fixed effect model is used to estimate the impact of shared-mining revenue on own-source revenue raising. The main argument is that the natural resource revenue sharing system gives mineral-producing districts no control over natural resource revenue management, so shared-mining revenue becomes exogenous for these districts.

The second aspect of the study in this thesis is to investigate the inter-correlation of environmental spending among districts in Sumatera and Kalimantan Island. Most districts in these islands are classified as resource-rich due to their natural resource endowments. On the other hand, these districts are claimed to contribute the most to incidence of environmental problems in Indonesia, including forest fires and pollution. The literature has suggested the presence of spatial interaction in environmental spending among neighbouring jurisdictions when externality exists. In other words, a local government will take into account their neighbouring governments' spending when spending externality exists. With regard to the environmental sector, both positive and negative externalities lead to non-optimal environmental spending. Hence, it is important to examine whether local governments in Sumatera and Kalimantan Island behave strategically in determining the size of their environmental spending.

The spatial interaction in environmental spending is estimated using spatial econometrics. This study uses district level data of physically neighbouring districts in Sumatera and Kalimantan for the period of 2009–2012. The study also develops the argument on the potential channels of spatial interaction in environmental spending interaction. The presence of pollution spillover, proxied by shared natural resource revenue, serves as a channel for positive spatial interaction. When a polluting district has a lack of environmental spending, it cannot address the environmental impact in its jurisdiction, and passes pollution to its neighbours. When the neighbouring district suffers and bears costs from pollution spillovers from neighbouring districts, it must increase its environmental spending to mitigate the impacts. The districts are split into two groups, mineral and timber producing districts and non-mineral and timber producing districts. Following the argument developed in this study, the lack of environmental spending in mineral and timber producing districts leads to pollution spillover and drives positive spatial interaction in environmental spending.

The third line of research considers an alternative fiscal transfer design to promote greater environmental spending at the local level. Compensation to local governments for environmental conservation costs is considered an important aspect to incentivize local governments in the area of environmental conservation policies (Ring & Schlaack 2010). The literature recognizes that fiscal transfer aims to address environmental conservation as ecological fiscal transfers (Ring 2002, 2008). To achieve national programs in environmental conservation, central government can involve local governments through the provision of fiscal transfers. Some countries use general purpose grants as the channel to transfer central government's financial support to local governments to manage forestry issues, called ecological fiscal transfer (see Ring 2008). Through this transfer, ecological indicators, including protected forest size, are included in the calculation of the size of general purpose transfers. This is mainly

motivated by the fact that districts with greater sized ecological endowments need greater expenditure for conservation. In some countries certain ecological indicators are included in the grant formula, hence it is called ecological fiscal transfer. Ecological fiscal transfers are allocated on the basis of ecological or conservation-based indicators, such as protected areas. Countries which have adopted this approach include Brazil (ecological ICMS at state level), Portugal which has incorporated an explicitly ecological dimension into the distribution of fiscal transfers from national or state levels to local governments in its Local Finances Law of 2007, and recently India (Ring 2008; Santos et al. 2012). The ICMS-E is an intergovernmental fiscal transfer from state to municipalities, which rewards municipalities for the creation of protected areas.

Although intergovernmental fiscal transfers are conceptually designed to provide benefits to local governments, many studies find negative effects of fiscal transfers on local governments' fiscal performance (Gamkhar & Shah 2007). Fungibility is an issue in fiscal transfer whereby the use of a grant is diverted to other unintended purposes. Hence, the targeted expenditure will be lower than expected and will reduce the effectiveness of the fiscal transfer. An approach to ensure the appropriate use of fiscal transfer is through conditioning fiscal transfer, called earmarked or conditional grants. This grant serves as a tool for central government to get local governments to implement national priorities and to internalize the externality or spillover across a neighbouring jurisdiction. Nevertheless, previous studies find grant fungibility in spite of the embedded conditionality (Duan & Zhan 2011; Wagstaff 2008). Hence, the design of fiscal transfers plays a crucial role in ensuring the effectiveness of the central government's fiscal transfer. The main purpose of this third study is to gain insight into the design of environmental fiscal incentives for resource-rich districts. This is done by evaluating the current central government's fiscal incentive.

The third study evaluates the current central government's incentive, the Regional Incentive Fund (RIF) or *Dana Insentif Daerah* on recipients' education spending. A difference in difference approach combined with a propensity score is used to evaluate the impact of this fiscal incentive on education spending in the recipient districts for three periods of analysis, 2009–2010, 2009–2011 and 2009–2012. Although this incentive is conditioned to education spending, fungibility is still likely, which can occur through non-additionality fungibility as the literature suggests. When fungibility is present in this fiscal incentive, there appears to be a need to consider alternative designs, possibly in the form of output-based transfers (UNCDF 2010; Shah 2007).

1.6 Contributions

This thesis contributes to knowledge by providing theoretical and empirical understanding of fiscal policies in resource-rich districts in Indonesia. The first study enriches the literature by developing the argument about the extent of the impact of the natural resource revenue sharing system on own-source revenue. The findings highlight further steps central government should take to encourage greater own-source revenue in mineral-producing districts. Although pollution spillover is a common environmental problem (Ulph 2000), the second study provides evidence that pollution spillover can affect environmental spending. This study expands the perspective on environmental management, which needs to include a fiscal policy dimension. The third study provides an insight to the Indonesian government on the effectiveness of the current design of the regional incentive fund.

2. IS MINING REVENUE SHARING A DISINCENTIVE FOR NON-RESOURCE REVENUE? AN EMPIRICAL STUDY IN MINERAL-PRODUCING DISTRICTS IN INDONESIA

Abstract

Shared mining revenue has been an important revenue source for mineral-producing districts. However, the average own-source revenue in mineral-producing districts in Indonesia is lower than in non-mineral producing districts. This paper investigates whether shared mining revenue is a disincentive for mineral-producing districts to raise additional own-source revenue. This paper uses a newly constructed revenue dataset of 302 mineral-producing districts for the period of 2001–2012. This study finds evidence that shared mining revenue does not become a disincentive toward the collection of local own revenue in mineral-producing districts in Indonesia. This results from the exogeneity of shared mining revenue. The study also finds a higher poverty rate in mineral-producing districts which contributes to the lower own-source revenue.

2.1 Introduction

Natural resources serve as an important element to promote economic development. Tax and non-tax revenue, employment for local people, and technology spillover effects are some of the benefits which are frequently expected to result from this sector. Revenue from extractive industries has dominated natural resource revenue in many resource-endowed countries (IMF 2012).

Despite the strategic role, previous studies undertaken at cross-country level point out that natural resource endowment leads to lower non-resource revenue (Thomas & Trevino 2013; Bolthole et al. 2012; Bornhorst et al. 2009; Ossowski & Gonzales 2012). McGuirk (2013) argues that a leader cuts tax revenue to keep citizens politically delinked, increasing the probability of survival for a leader of a resource-rich country. Although there is a large body of studies on the nexus between non-resource and resource revenue (see Bornhorst et al. 2009; Thomas and Trevifio, 2013) , there are limited studies which investigate this issue at sub-national level. Particularly under fiscal decentralization, the question of whether low non-resource revenue is a result of natural resource endowments needs to be explored further. High reliance on natural resource extraction brings negative side effects, including rampant corruption, lack of accountability and environmental consequences (see Resosudarmo et al. 2012). Besides, natural resource revenue is not sustainable over the long term and can adversely affect local governments' fiscal capacity.

The average tax and retribution revenue for the period 2001 to 2012 in mineral-producing districts in Indonesia was lower than the tax and retribution revenue in non-mineral-producing districts. Following previous studies at cross-country level, this lack of tax and retribution revenue may result from the natural resource endowment they have. However, due to fiscal arrangements under fiscal decentralization, the findings at

cross-country level need to be tested at sub-national level. This study aims to examine whether natural resource-revenue sharing, in particular shared mining revenue, has discouraged revenue efforts in mineral-producing districts. The answer to this question has important implications for strengthening fiscal policy at sub-national government level.

This paper develops the argument that the extent of sub-national government control over resource revenue assignment plays a central role in determining the effects of natural resource endowments on non-natural resource revenue. When sub-national governments do not have control over natural resource revenue collection, there is no incentive for sub-national governments to substitute non-resource revenue. This paper aims to test this argument by examining revenue efforts in 491 districts in Indonesia and specifically focusing on 302 mineral-producing districts. The findings of this paper have two benefits: (i) to provide an alternative answer for persistent stagnant growth of sub-national tax revenue, which is still limited in the literature, and (ii) to fill in the gap in studies on the effect of natural resource endowment on revenue efforts at the sub-national level.

This paper is organized as follows. Section two discusses the literature and conceptual framework. Section three discusses some facts about fiscal policy in mineral-producing districts in Indonesia. Section four focuses on data and methodology and is followed by interpretation and discussion. Section five wraps up and provides policy implications.

2.2 Literature review

Recent studies have empirically analysed the impact of natural resource wealth on a country's non-natural resource revenue efforts. Bornhorst, Gupta, and Thornton (2009) examine panel data for 30 hydrocarbon-producing countries (oil and gas). They find that

the ratio of non-hydrocarbon revenue to GDP is inversely related to the ratio of hydrocarbon revenue to GDP and a 1 percentage point increase in hydrocarbon revenue (in relation to GDP) lowers non-hydrocarbon revenues by about 0.2 percentage points. Crivelli & Gupta (2014) find a statistically significant negative relationship between resource revenue and total domestic revenue in 35 resource-rich countries. Geographically based studies also find a negative correlation between these two variables. Thomas and Trevino (2013) and Bolthole et al. (2012) find that non-resource revenue is negatively influenced by a higher resource revenue-to-GDP ratio in resource-rich countries in Sub-Saharan Africa. Ossowski and Gonzales (2012) also find a negative effect of natural resources on non-natural resource revenue in resource-rich countries in Latin America and the Caribbean. Kaghazian et al. (2013) and Eltony (2010) find negative relationships between tax efforts and oil incomes in oil-rich Arab countries.

Although the low level of tax revenue is attributed to, among other factors, inadequate enforcement, low levels of accountability, lack of oversight and weak administrative capacity, previous studies in the literature have developed arguments regarding the low tax revenue in natural resource-rich countries. Bolthole et al. (2012) argue that institution quality is crucial for the contribution of natural resources to tax revenue mobilization. Moore (2007) argues that governments relying on resource rents and aid are likely to mobilize less revenue from other income sources. As a consequence there is less incentive to build up the political and organizational capacities of the state. The avoidance of broad-based taxes lowers citizens' demands for better public spending, lowering the political costs and collection costs for government. This explains why countries with higher resource revenue have lower domestic tax revenue. In the same vein, McGuirk (2013) suggests that in the presence of high natural resource rents,

leaders lower the burden of taxation on citizens in order to reduce demand for democratic accountability.

Leite and Weidmann (1999) argue that natural resource abundance creates opportunities for rent-seeking behaviour and is an important factor in determining a country's level of corruption. In turn, rampant corruption results in lower tax revenues (Thornton 2008). Various studies attempting to investigate the determinants of tax revenues find that the corruption level is one of the most important determinants of tax revenue (Gupta 2007; Imam & Jacobs 2007; Bird et al. 2008). Thomas & Trevino (2013) find that lower non-resource tax revenue in resource high countries is correlated with higher levels of corruption rather than any differences in statutory tax rates. Corruption becomes a fertile ground for tax evasion, large tax exemptions, and/or weaker enforcement.

2.2.1 Natural resources and fiscal decentralization

The shifting of some responsibilities for expenditures and revenues to sub-national governments is at the core of fiscal decentralization. If sub-national governments carry out decentralized functions effectively, they must have an adequate level of revenue, either raised sub-nationally through local taxes and charges, or transferred from the central government. One potential revenue source for local governments to effectively provide public services is revenue from their resource wealth. Therefore, the negative effect of natural resource revenue on non-resource revenue, as argued by previous studies at country level, can be realized as well at local government level.

A previous study from Freinkman and Plekhanov (2009) finds that local governments which rely on federal transfers and natural resource rents for a major share of their revenue may face distortion in their fiscal performance. In the context of a sub-national economy, this study shows that natural resource-revenue sharing becomes a potential

channel for disincentive effects on higher non-resource revenue efforts. Previous studies also find a negative effect of natural resource revenue on macroeconomic variables. James and Aadland (2011) find that resource-dependent counties exhibit more anaemic economic growth. Papyrakis and Gerlagh (2007) examine county and state levels in the US and find that natural resource abundance decreases investment, schooling, openness, and R&D expenditure and increases corruption. Partridge et al. (2012) find that dependence on coal mining in the Appalachian mountain region has contributed to deep poverty in this region.

James (2013) uses forty-two years of US state-level data and finds that a 1 percentage point increase in resource revenue results in a 0.2 percentage point decrease in non-resource revenue. He develops the argument that in response to an exogenous increase in resource-based government revenue, a benevolent government will partially move away from taxing income, increasing spending and saving. The substitution of non-resource for natural resource revenue has also been raised by Crivelli & Gupta (2014). In addition to the negative effect correlation, they find that substitution between natural resources and tax revenue occurred in 35 resource-rich countries during 1992–2009, where the econometric estimation shows that 30 cents in non-resource tax revenue are lost with each additional dollar in resource revenue.

2.2.2 Natural resource revenue assignment

Under fiscal federalism, a central government distributes natural resource revenue to lower level governments. This revenue distribution also serves to mitigate the vertical imbalance between the central government, and local governments which produce natural resources. Among available methods for resource revenue distribution, revenue sharing is commonly used although it is not an attractive general instrument for financing sub-national governments, since it reduces accountability. When a central

government controls natural resource revenue policy and regulates resource-revenue sharing, the role of local government is minimal. Therefore, beneficiary governments are not responsible for the burden they impose on their citizens (Brosio 2006). In other words, local governments still receive the agreed sharing amount regardless of local economic performance through resource-revenue sharing.

In natural resource-rich countries, the sharing of natural resource rent is more complicated in fiscally decentralized countries than in non-fiscally decentralized ones. In non-fiscally decentralized countries, natural resource revenue assignment is generally centralized at central government level or is fully centralized. The central government pays all the expenses of lower level government. However, under fiscal decentralization the demand from sub-national governments to benefit from their natural resource wealth is greater and may become seeds for secession when the sharing is deemed unfair. This case shows that an optimal natural resource transfer is needed.

The allocation of control of natural resource revenue to sub-national governments gives rise to some concerns as resource revenue assignment to sub-national governments does not come without consequences. Brosio and Singh (2014) argue that local governments do not have the same capacity to face resource revenue related problems, such as revenue volatility, mobility of factors, likely misspending of the rent and the potential for corruption. In the same line, Ahmad and Mottu (2002) posit that when sub-national governments have other assigned non-resource taxes, oil-rich regions may have incentives to use non-resource revenue bases, which may lead to misallocation of factors of production[1].

[1] A study from James (2013) finds a negative effect of resource revenue on non-resource revenue in coal producing counties.

Despite the arguments against assigning resource revenues to sub-national governments, there are several reasons which favour this option (see Brosio 2006, pp. 451–454). The need for additional investment in infrastructure aiming to support the development of mining businesses requires local governments to have sufficient financial resources to ensure they can provide this. Local community is the most directly impacted party as a result of resource-based industries. This emphasizes the strategic role of local government in determining a socially efficient level of natural resource use to overcome the externality (Brosio & Singh 2014). Another argument is that is the central government can reassign certain expenditure to resource-rich local governments for strategic and national-interest projects.

Following Brosio (2006), there are five types of fiscal arrangement for revenue-sharing assignment between central and local governments, as shown in Table 2-1. The first method is the separation of taxing authorities. The national and local governments separately impose taxes on natural resources on firms or projects located within their jurisdiction. For example, royalties might be assigned to sub-national governments, whereas profit or resource rent taxes are assigned to the central government. Under this system, local governments possess control over natural resource revenue. The important aspect is that this system requires fiscal policy coordination between national and sub-national governments. This system is commonly found in federated nations such as the US, Argentina, Brazil, Canada and Australia.

Table **2-1 Resource revenue assignment method**

Method	**Separation of Tax Bases (own-source taxes)**	**Concurrence of Taxes (sharing of tax bases)**	**Sharing of Revenue**	**Sharing of Revenue In-Kind**	**Intergovernmental Transfers out of Revenue from Natural Resources**
Determination of the tax base	Sub-national	National	National	Mostly national	National
Determination of the tax rates	Sub-national	Sub-national (within limits)	National	Mostly national	National
Administration	Sub-national	Mostly national	National	By the producing firm	Mostly national
Criterion for beneficiary jurisdiction	Origin	Origin	Origin	Origin	Need, equity, or other

Source: Brosio 2006, p. 441.

The second method is concurrence of taxes or tax base sharing. With this method, central and local governments use the same tax instrument. For example, the national government can determine the tax base, and the sub-national government determines the tax rate. However, there is concern about potential excessive government take and such a system may lead to a retrenchment of investors and cause a decrease in production.

The third method is tax-revenue sharing, where the tax bases, tax rates and revenue shares are determined by the central government and the revenue is allocated according to an agreed rate based on the origin principle. Indonesia and Nigeria have adopted this method. The fourth method is in-kind revenue sharing where sub-national governments have access to a share of natural resource revenue generated within their jurisdiction via the provision of infrastructure by the companies that exploit these resources, and on the basis of an explicit national regulation. The last method is intergovernmental transfers based on the revenue from natural resources.

2.2.3 Conceptual framework

Through taxing its citizens, government collects financial resources to undertake public service tasks. In return, citizens demand better public policies and require higher

accountability for the use of tax money paid. This relationship establishes a political relationship between government and citizens. However, when governments have alternative financial sources rather than taxation, they are likely to prefer not to tax their citizens. In natural resource rich countries, it is argued that governments prefer to collect income from natural resources, rather than using taxation as a budget source. Less taxation would reduce the need for accountability, and also reduce incentive for citizens to scrutinize the government (see Collier & Hoeffler 2005). Under weak governance and low institution quality, the lack of citizens' scrutiny results in the abuse of resource revenue. Resource money will be used to maintain power by reducing checks and balances in the political system. Therefore, previous studies find that resource-rich countries are less democratic (Collier & Hoeffler 2005), and their tax efforts are lower than in resource-poor countries (Thomas & Trevino 2013; Bolthole et al. 2012; Bornhorst et al. 2009). Government discretion to collect more resource revenue or taxes is motivated by the quality of governance or institution (see McGuirk 2013; Moore 2007).

However, at sub-national level, the situation will be different, depending on the fiscal mechanism of resource revenue assignment applied. Among the five fiscal systems of resource revenue sharing between different layers of government, each method has its own implications for local government control. When sub-national governments do not have control over determining the amount of resource revenue they receive from resource wealth, non-resource revenue will not be affected. Regardless of the non-resource revenue amount, the sub-national government still needs to collect non-resource revenue to cover its spending. Conversely, when local governments have broader control over determining shared mining revenue, they have budget financing options, whether from resources or from taxation. A resource-rich local government can

switch its budget financing component from non-resource to resource revenue. Similar to at the country level, when local governments have broader authority over resource revenue determination, there is incentive to partially move away from non-resource taxation (see James 2013). Therefore, the type of natural resource revenue assignment plays an important role in linking resource wealth and revenue efforts at the local government level.

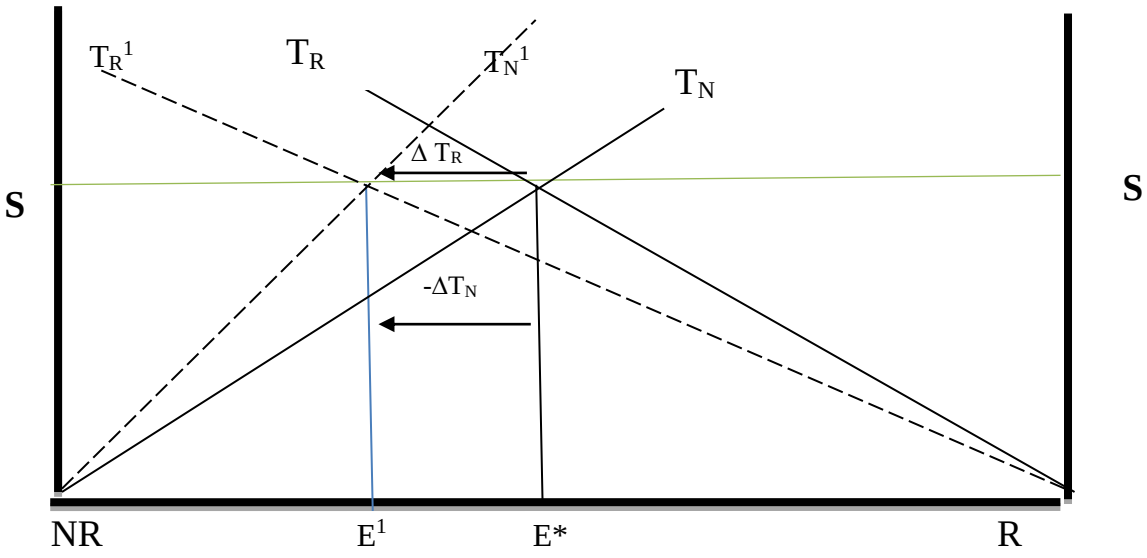
I differentiate the resource revenue assignment based on the level of control of local government in resource revenue collection. When resource-producing local governments do not have control over resource revenue collection[2], such as resource-revenue sharing, local governments do not have revenue alternatives to offset the lower non-resource revenue. Regardless of the non-resource revenue amount, the resource revenue they receive will only be based on the agreed percentage. As a result, sub-national governments will make optimal efforts to increase non-resource revenue when total revenue is still insufficient to cover total spending.

Take a local government which is considering collecting revenue from natural resources (R) or non-natural resource (NR). Assume revenue options only comprise resource tax and non-resource tax or own-source revenue. When a government has control over resource revenue, it can choose to raise a non-resource tax or resource tax. This situation is illustrated in Figure 2-1. The horizontal axis measures total revenues both from resource tax and non-resource tax. The points to the right of NR show the non-resource revenue, and the points to the left of R indicate resource revenue. The vertical axis represents total expenditure (S).

[2] This implies the absence of power of local government in the determination of the tax base, tax rate and its administration.

The two bold lines, T_R and T_N represent the total revenue for resource revenue and non-resource revenue respectively. The non-resource revenue, own-source revenue in this case, includes the utilization of tax rate and tax base. The intersection point (E*) determines the optimal combination of non-resource revenue (T_N) and resource revenue (T_R) to cover total spending (S). A resource-producing local government has two options to cover its spending. It can increase own-source revenue or increase resource revenue when it has control over natural resources revenue. This resource revenue control potentially becomes an incentive to replace non-resource revenue with resource revenue. When a local government has control over resource revenue, the greater resource revenue will be collected by moving to new revenue composition at E^1 where the new dotted resource line (T_R^1) and non-resource line (T_N^1) intersect. The increase in resource tax (ΔT_R) offsets the decrease in non-resource tax ($-\Delta T_N$) and leads to lower non-resource revenue.

Figure 2-1 **Tax effort selection in full control district**

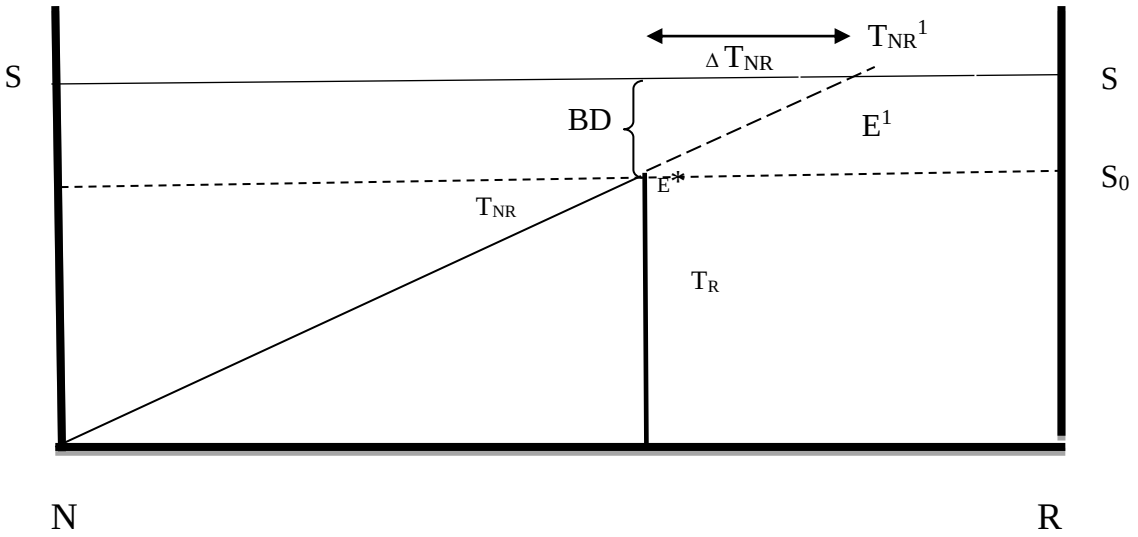


Now consider when a local government does not have control over resource revenue collection, as represented by the bold flat line T_R in Figure 2-2. This line implies that resource revenue is exogenous and a local government does not have control over it. In

this case, the resource revenue is transferred by central government through shared resource revenue. The upward sloping line T_N represents non-resource revenue; the point further right from N implies higher non-resource revenue. The upward sloping line implies that higher non-resource revenue is needed to close the budget gap. The intersection point E^* is the composition between non-resource revenue and a given shared resource revenue. It is assumed there are two revenues, non-resource revenue or own-source revenue and shared resource revenue. When shared resource revenue and non-resource revenue only cover total spending at S_0 and do not cover total spending as represented by BD, local government needs to make extra effort by scaling up non-resource revenue as represented by T_{NR}^1. Because shared resource revenue is exogenous, the non-resource revenue will change (ΔT_{NR}) to cover total spending.

This posits that under centralized natural resource revenue, the impact of natural resource revenue on the resource revenue effort will be absent. As a local government does not have control over natural resource revenue collection, it cannot substitute its non-natural resource revenue for natural resource revenue. Hence, regardless of the amount of natural resource revenue transfer, a local government still needs to collect non-resource revenue to close the budget gap.

Figure 2-2 **Tax effort selection in no control district**



2.3 Background of own-source revenue at sub-national government level

Under the principle of fiscal decentralization, fiscal authority devolution must be accompanied by fiscal support from central government to lower levels of government. Due to broader fiscal responsibility at the central level, fiscal devolution to lower governments is limited and intergovernmental transfers will help support local government budgets. District tax revenue over GDP in Indonesia was only 0.1% in 2001 and jumped to 0.3% in 2012, which is still lower than the central tax ratio which accounted for 11% and 12% respectively as Table 2-2 shows. This national revenue structure is common under fiscal federalism. For the case of Australia, where city governments are only eligible to collect property taxes, the local tax effort is relatively stagnant, at 0.9% in 2001 and remaining at 0.9% in 2012. Although this figure is lower when compared to other developed economies, the average local tax ratio in developed countries is higher in developing countries. Table 2-2 shows the comparison of different levels of tax ratio among selected countries.

Table 2-2 **Cross-country tax ratio comparison at each level of government (in percentage)**

COUNTRY	CENTRAL/FEDERAL				STATE				MUNICIPALITY/DISTRICTS(*)			
	2001	2005	2010	2012	2001	2005	2010	2012	2001	2005	2010	2012
AUSTRALIA	24	25	21	22	4	4	4	4	0.9	0.9	0.9	0.9
CANADA	18	17	16	16	13	12	12	12	3	3	3	3
GERMANY	26	25	26	26	8	8	8	8.	3	3	3	3
USA	19	17	15	16	5	5	5	5	3	4	4	4
MEXICO	17	18	18	19	0.4	0.4	0.5	N/A	0.2	0.2	0.2	N/A
INDONESIA	**11**	**13**	**11**	**12**	**0.5**	**0.7**	**0.7**	**0.9**	**0.1**	**0.2**	**0.2**	**0.3**

Note: the tax ratio percentage denotes the total tax revenue at each level of government over national total GDP. Despite the division of government level, Indonesia is not federal country. Figures are rounded. (*) denotes second third tier level of government.
Source: OECD online database http://www.oecd.org/ctp/federalism/oecdfiscaldecentralisationdatabase.htm#C_4, and the Indonesian government Financial Note for various years.

Own-source revenue is defined as revenue that is withheld based on local regulations in accordance with legislation, for the purposes of financing activities. Local own-source revenues or *Pendapatan Asli Daerah* (PAD) in Indonesia consist of local taxes, charges or fees, the income of local government owned corporates, and other local government revenue. The assigned local tax collection is distinguished at provincial and district levels (*kabupaten* and *kota*).[3] Mobile tax objects, such as vehicles, are assigned to the provincial level. However, immobile tax objects, such as property, are assigned to the district level[4]. Most of these district taxes can be classified as consumption and wealth taxes. On the other hand, income taxes including personal income tax (PIT) and wage tax are collected by central government and distributed through fiscal transfers. Table 2-3 shows a list of taxes and fees collected at district and provincial levels.

[3] District level is the third layer of government after national and provincial level. District is classified into two, *kabupaten* and *kota* (city). This classification is based on demography, area size and income source. *Kabupaten* has a wider area but lower population density and is more dominated by the agriculture sector.
[4]Since 2012 property tax administration has been transferred to local governments, however, only 17 districts were ready then. By 2014, property tax was fully administered by local government.

Table 2-3 **Types of taxes and fees collected at provincial and district levels**

Provincial taxes	**District taxes**
• Motor Vehicle Tax; • Excise/Tax For Transfer of Ownership of Motor Vehicle; • Motor Vehicle Fuel Tax; • Surface Water Tax; • Cigarette Tax.	• Restaurant Tax; • Entertainment Tax; • Advertising Tax; • Street Lighting Tax; • Tax on Non-Metal Mineral and Rock; • Parking Tax; • Ground Water Tax; • Tax on Swallows' Nests; • Rural and Urban Land and Building Tax; • Excise/Tax for Acquiring Right on Land and Building.
District charges	
Public Services	e.g. Retribution for Health/Medical Services; Retribution for Garbage Disposal/ Cleanliness Services
Business Services	e.g. Retribution for the Utilization of Regional Assets; Retribution for Wholesale Markets and/or Shops; Retribution for Auction Venues
Certain Permits	e.g. Retribution for Building Construction Permit; Retribution for Permits for Venues Selling Alcoholic Beverages; as well as the use of natural resources

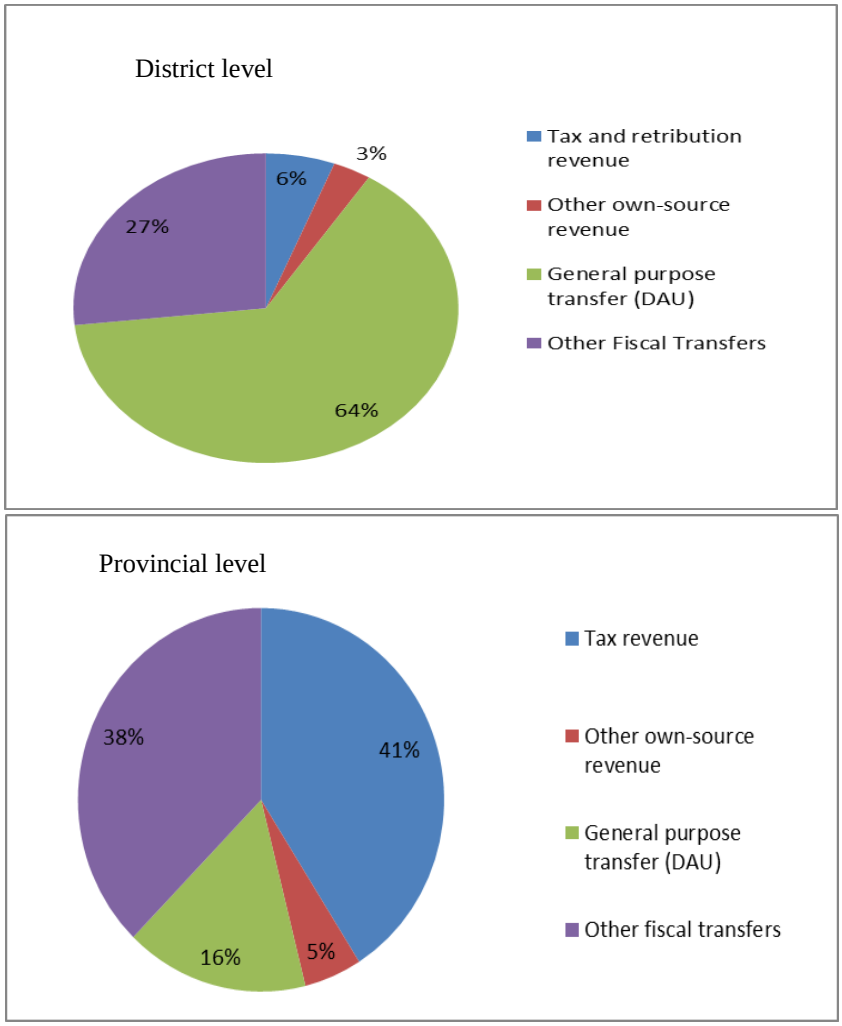
Source: Law No. 28 Year 2009

The tax assignment to local government employs a closed list system, where only limited tax objects are assigned to local government. The rationale of this policy is to avoid excessive new taxes and fees by local governments for their budget, so that they can promote a fertile new investment environment.

Figure 2-3 displays the role of each revenue type on total revenue at district and province levels for the period 2001–2012. At district level, fiscal transfer dominates total revenue by 91% and total own revenue (tax + retribution and other own revenue) is only 9%. On the contrary, at provincial level, total own revenue significantly dominates revenue composition, accounting for 46.1%, with 54.8% coming from fiscal transfers. The contribution of tax and retribution revenue to total revenue at provincial level plays a significant role, accounting for 41%. At the provincial level, the fiscal transfer component is dominated by tax sharing, accounting for 15.3%, and general allocation grant (block grant) for 19.3%. On the other hand, the general allocation grant dominates the fiscal transfer composition at district level accounting for more than 64%, followed by revenue sharing from natural resources and shared taxes. Although districts have

more types of tax and retribution for services provided than provinces do, the different sizes of tax bases and tax rates are the cause of the gap.

Figure 2-3 **Composition of average revenues by type at district and provincial level (2001–2012)**



Source: Own calculation based on Indonesia statistics office data

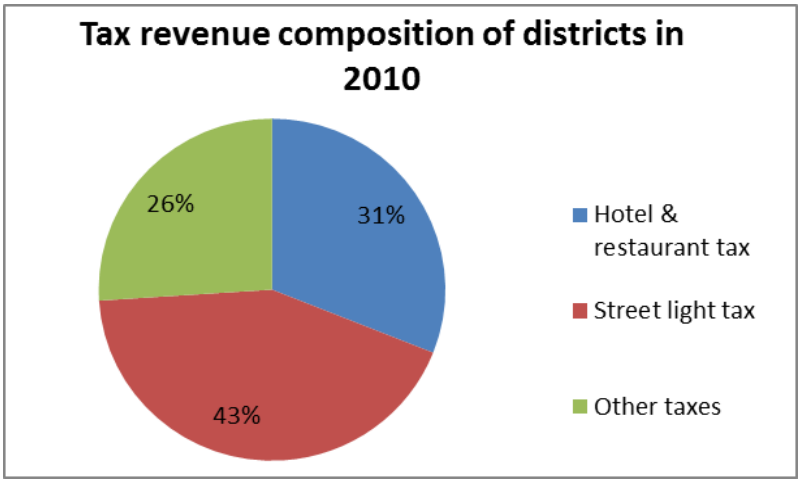
2.3.1 Is the district tax base too narrow?

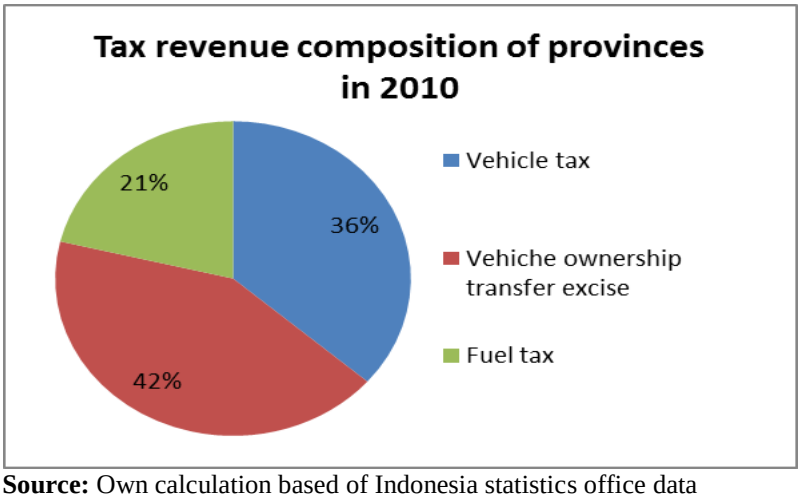
The different types of taxes at provincial and district levels, as elaborated above, would have different contributions to revenue, which is based on the characteristics of particular tax objects. Figure 2-4 shows the contribution of major types of tax at district and province levels. The contribution of street lighting tax dominates tax revenues at district level, accounting for 43%, followed by hotel and restaurant tax. The tax base of

the street lighting tax, i.e. the sale value of electricity, is imposed on assigned electricity consumers, and withheld by state-owned electricity companies.

Hotel and restaurant taxes are imposed on the services and goods provided by hotels and restaurants, including the sale of food and/or beverages consumed by buyers. The tax base is the total payment paid to hotels and restaurants. The street light tax and hotel and restaurant tax can be classified as consumption taxes, which is a tax on goods and services consumed by users.

Figure 2-4 **Revenue composition at district and provincial level**





Source: Own calculation based of Indonesia statistics office data
Note: Due to data unavailability, the calculation only covers 353 districts. The calculation also excludes Jakarta province.

On the other hand, vehicle ownership transfer taxes dominate provincial tax revenue accounting for 34%, followed by vehicle taxes accounting for 28%. The tax base of

motor vehicle tax is the result of multiplication between the sale value and the weight of the vehicle. In principle, these wealth tax types are imposed on the ownership of vehicles. Another dominant type of provincial tax is the vehicle fuel tax. This consumption tax type is imposed on the basis of the value of fuel, before VAT, used for vehicles.

The different types of taxes at province and district levels would result in different effects on the revenue side. All taxes collected at district level apply a withholding system, where the withholders have been clearly assigned by the law. On the contrary, an official assessment system applies for most provincial taxes. Conversely, provincial taxes are assessed by assigned tax officers who assess taxable asset values and issue the tax payable notices. Despite the complexity, the value of taxes collected can approach the tax potential.

Hotel, restaurant and street lighting tax rate have a maximum of 10%. Vehicle tax applies a progressive tax rate with a maximum of 1% for the first vehicle, and a maximum of 10% for the next vehicle owned. Various rates apply for vehicle ownership transfer tax; the maximum rate is 20% for a first time transfer and 1% for the next transfer[5]. Fuel tax applies with maximum rate of 10%.

Table 2-4 shows the trends of restaurant income and output values of four wheeled vehicles for the period 2007–2010. On average the potential tax base of vehicle ownership transfer is almost four times bigger than the tax base from the restaurant sub-sector.

[5] Previously maximum rate for vehicle ownership transfer was maximum 10% and increased to 20% along with the introduction of law number 29 year 2009. The province head has discretion on determining vehicle ownership transfer tax for first delivery. There is competitive tax rate among provinces, for example, Jakarta and West java province imposes 10%. These two provinces are neighboured. 15% rate applies in in East Java and Bali province.

Table 2-4 **The development of restaurant and automotive sector (trillion IDR)**

Sector	2007	2008	2009	2010
Restaurant income (medium and large scale business)	7	8	9	10
Production value of four wheeled vehicles or more	35	57	44	63

Source: Own calculation based on BPS, restaurant statistics:http://www.bps.go.id/eng/hasil_publikasi/flip_2011/8204004/index11.php?pub=Statistik%20Restoran/Rumah%20Makan%202010 \, and Ministry of Industry data: http://www.kemenperin.go.id/statistik/ibs_tahun.php?tahun=2009.
Note: Figures are rounded

2.3.2 Is there a difference in natural resource-endowed districts?

The previous section has shown the lower own-source revenues to total revenue at district level compared to provincial level. The different tax base plays a crucial role in determining tax revenues at local government level. In addition, the locality factor or local specifics also play a crucial role in determining tax revenue (Drummond et al. 2012; Ehrhart 2009; Gupta 2007).

A further analysis at district level shows the significant gap between revenue mineral-producing and non-producing districts. From four types of intergovernmental transfer, grants (DAU), earmarked grants (DAK), tax-revenue sharing, and natural resource-revenue sharing, the natural resource producing districts are entitled to a higher portion of natural resource-revenue sharing. This is an additional fiscal transfer from the utilization of their natural resource endowments. In addition to budget support, this resource-revenue sharing aims to offset the district horizontal inequality due to different natural resource endowments.

The types of natural resource revenue have been established in law number 33/2004, including natural resources from (1) forestry, (2) mining, (3) fishery. The revenues from mining can be grouped into oil, natural gas, geothermal, and general mining. Since 2006, shared natural resource revenue has also included a forestry reforestation fund,

which is a diversion from the Specific Purpose Fund Reforestation Funds. The sharing portion can be seen in Table 2-5.

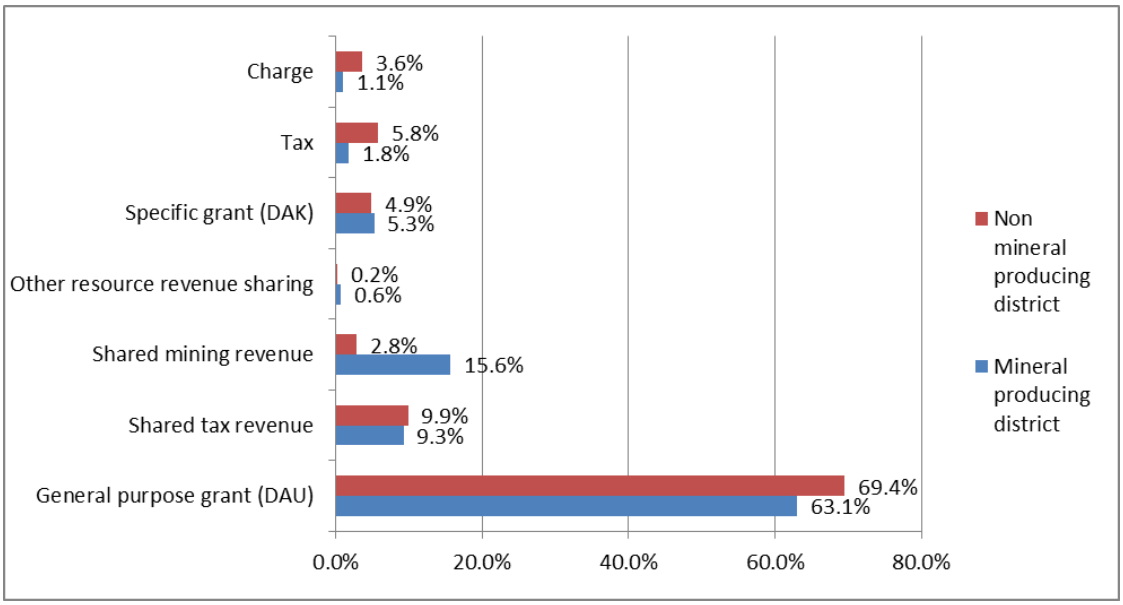
Table 2-5 **Natural resource-revenue sharing allocation**

Sources	Central	Province	Producing districts	Other districts (equally distributed)
Forestry:				
(1) Reforestation fund	60%		40%	
(2) Forestry provision royalty (PSDH)	20%	16%	32%	32%
(3) Forest tenure licence fees (IIUPH)	20%	16%	64%	
Fishery (fishery fee and fishery licence fee)	20%		80%	
Mining:				
General mining				
a. Land-rent	20%	16%	64%	
b. Royalty	20%	16%	32%	32%
Oil	84.5%	3.1%	6.2%	6.2%
Gas	69.5%	6.1%	12.2%	12.2%
Geothermal	20%	16%	32%	32%

Source: Law 33/2004

Mineral-producing districts receive a significant portion of resource sharing for general mining (including coal, gold). There were 302 mineral-producing districts out of 491 districts (*kabupaten* and *kota*) in Indonesia in 2012 which were classified as mineral-producing districts as decreed by the Minister of Energy and Mining number 2300 K/80/MEM/2012. Figure-2-5 shows the significant role of natural resource revenue among other types of fiscal transfer. In total, mineral-producing districts receive higher fiscal transfers, accounting for 16 percent of total revenue. Because shared natural resource revenue serves as a subtraction factor in general purpose grant (DAU) allocation, the portion of DAU in total revenue is only around 63 percent, which is lower than in non-mineral producing districts, which account for 69 percent. Despite the high portion of fiscal transfers, producing districts have lower own-source revenue ratios than non-producing districts, as Figure 2-5 shows. The average tax revenue over total revenue is significantly higher in non-mineral producing districts, accounting for almost 6 percent, compared to only around 2 percent in mineral-producing districts. Similarly, the average charge revenue is higher in non-mineral producing districts.

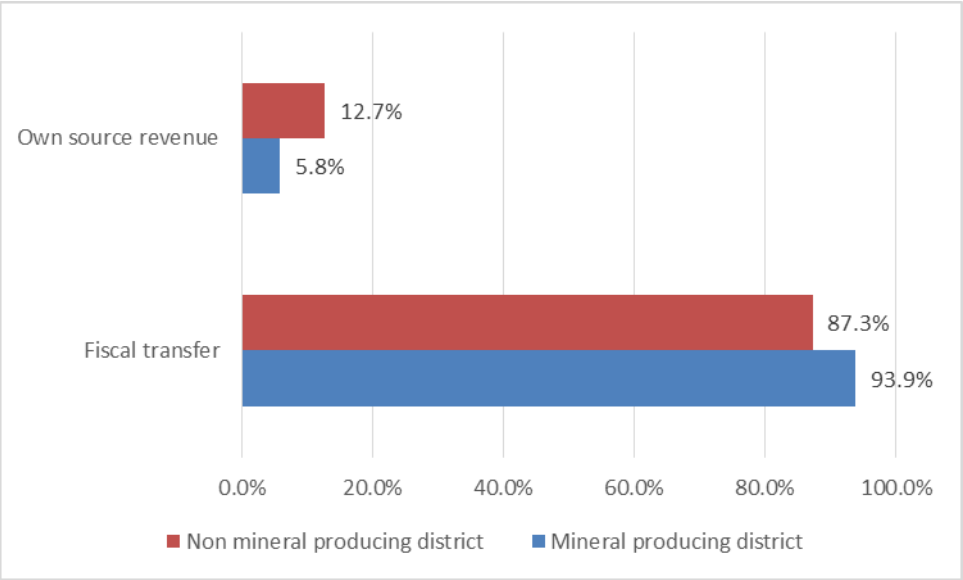
Figure 2-5 **Revenue composition at district level (Average 2001–2012)**



Source: Own calculation based on DGFB data.
Note: The figure is the percentage of each type of revenue over total revenue. Other resource-revenue sharing consists of forestry and fishery revenue sharing.

The greater shared-natural resource revenue received by mineral producing districts reflects greater fiscal capacity in this group. However, the fiscal transfer dependency is own source revenue over total revenue. Figure 2-6 shows the portion of fiscal transfer in mineral producing districts accounts for 94%, which is much higher than in non-mineral producing districts accounting for 87%.The portion of own-source revenue is also higher in non-mineral producing district accounting for 13%. By contrast, the portion of own-source revenue is mineral producing districts account for only almost 6%.

Figure 2-6 **The composition of total fiscal transfer and own-source revenue (% of total revenue)**



Source: Own calculation based on DGFB data.
Note: Figure is the average of 2001-2012.

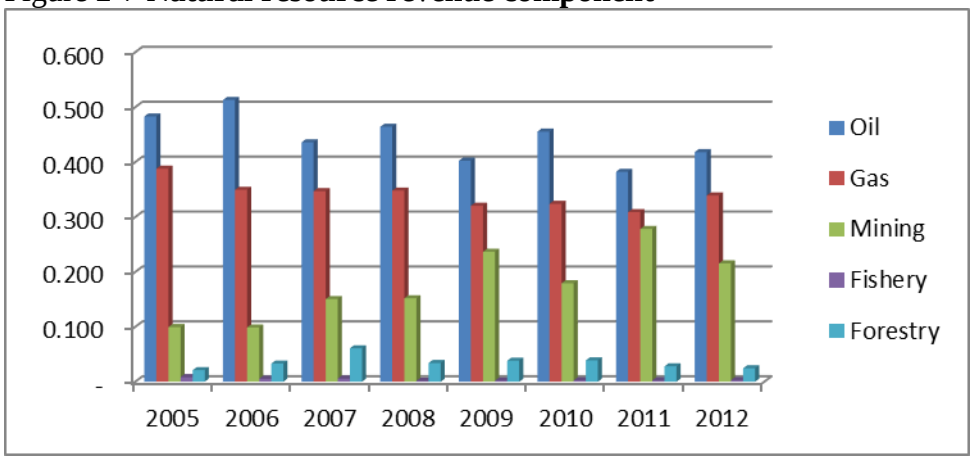
2.3.3 Natural resource-revenue sharing in Indonesia

Natural resource revenue makes an important contribution to Indonesia's economic growth and government budget. Despite the declining trend over the years, the role remains important in central government budget composition. Agriculture, forestry, and mining contributed about 28% of Indonesia's GDP in 2000 and about 19% in 2012. This sector contributed about 22% of central government revenue in 2012, declining from 38% in 2001. As total natural resource revenue is dominated by oil and gas, decreased drilling for oil and shifts in other types of national revenues have led to a downward trend in natural resource revenues in central government revenue composition.

The central government distributes non-tax receipts from natural resources through natural resource-revenue sharing to eligible districts based on certain formula. Figure 2-6 shows that oil revenue dominates the revenue sharing with an average of 44%,

followed by gas and mining. Although oil and gas revenue show a declining trend, the contribution of the mining sector shows an upward trend to offset the lower role of oil and gas revenue.

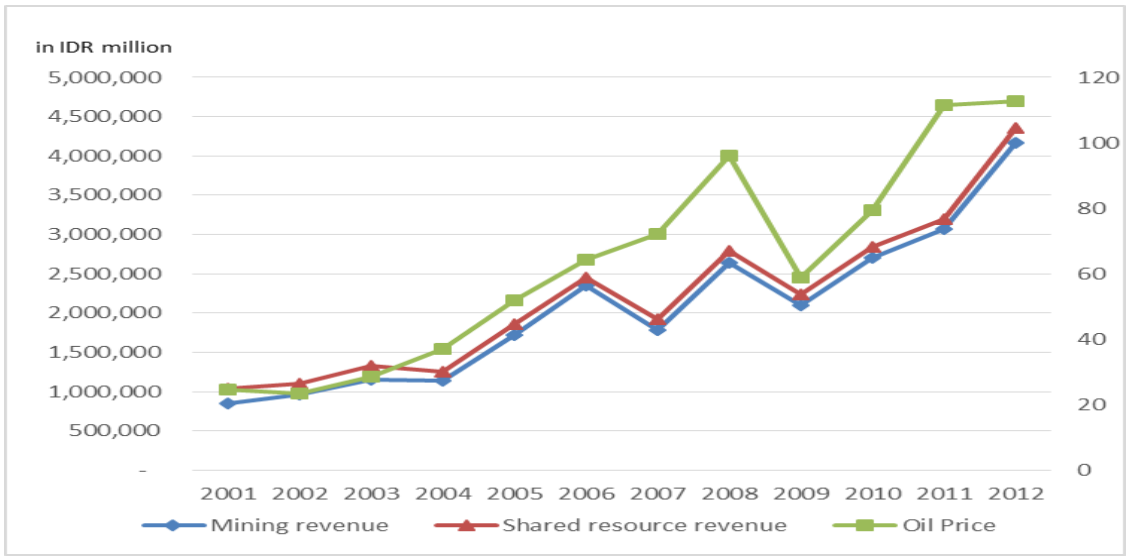
Figure 2-7 **Natural resource revenue component**



Source: Own calculation based on World Bank-Indodapoer
Note: The figures include provincial allocation. Mining refers to non-oil and gas.

In line with the dominant role of oil revenue, the development of natural resource revenue has been dominated by the development of oil price. Figure 2.8 shows the development of shared mining, shared natural resource revenue and the development of oil price.

Figure 2-8 **The development of real shared mining, real shared natural resource revenue and oil price**



Source: Own calculation based on World Bank-Indodapoer and Annual Financial Note

Figure 2-8 clearly points out the development of oil price during this period has supported the growing shared natural resource revenue to local governments.

2.4 Data and methodology

2.4.1 Data

This paper uses unbalanced panel data, obtained for 544 districts for the period 2001–2012. The dataset does not include the DKI Jakarta districts because local tax and retribution are administered at the provincial level. The mineral classification includes oil, geo thermal, coal and other types of extractive commodities. In addition to receiving special allocations from resource-revenue sharing from minerals, they also receive revenue sharing from fisheries and forestry. In this paper, I consider only the district level due to different types of taxable and chargeable objects between the provincial level and the district level.

The analysis draws mainly on three sources of data. At the core is the panel data on Indonesian local governments' public finances, which is obtained from the Directorate General of Financial Balance at the Ministry of Finance. This study also benefits from the World Bank INDODAPOER database. The data relating to natural resource-revenue sharing and other intergovernmental transfers are obtained from natural resource revenue transfer reports published by the Directorate General of Financial Balance (DGFB). The public finance data, including districts' own-source revenues, taxes and retribution, and intergovernmental fiscal transfers, are obtained from the Ministry of Finance and biannual financial statistics of district and city reports published by the statistics office. I also refer to the Finance Minister's decree, audited resource sharing transfer audit report from 2009–2012, and central government financial report for the period of 2005–2008 on the realization of natural resource revenue transfers to local government. The shared mining revenue in this paper only includes oil, gas and rock

minerals. The revenue sharing from the fishery and forestry sectors is grouped into other natural resource-revenue sharing.

The data for regional gross domestic product are obtained from yearly reports of regional gross domestic product published by the statistics office. The RGDP deflator is used to measure price increases. Other data, including population, trade, hotel, and restaurant share of GDP, literacy rate, household access to electricity, poverty rate and percentage of population in urban area are obtained from the INDODAPOER database.

The number of districts grew from 336 in 2001 to 491 in 2012. This proliferation brings consequences of changing characteristics in the original districts. This paper differentiates the original district by before and after proliferation. For the purpose of econometric estimation, I assign new district codes for original (old) districts after proliferation. In this way, the econometric estimation will recognize the original districts' codes as different units. Hence, there are a total of 544 districts.

All economic and fiscal data are real term data, where nominal data are deflated by each district's RGDP deflator. This aims to minimize data distortion due to price movements. Table 2-6 displays the descriptive statistics of data used in this study for all districts. Several variables show significant data variation, including mining revenue sharing and RGDP per capita. This particularly results from the high share of mining revenue sharing for high natural resource districts in the province of East Kalimantan, the province of Riau, the province of Island of Riau, Jambi and South Sumatera. Mining dominates the economic output in these districts. Most data in this study are skewed right.

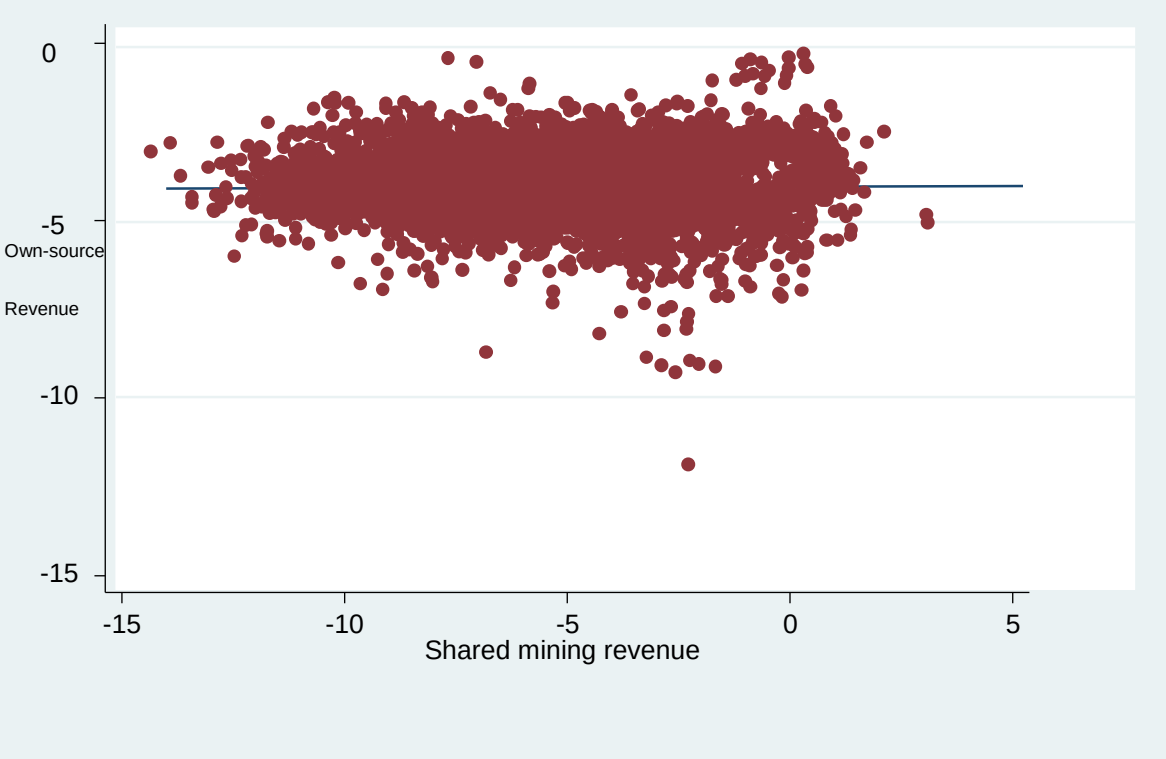
Table 2-6 **Descriptive statistics**

Variable	N	Mean	Std. Dev.	Min	Max
Own revenue/capita	5131	.030	0.051	0	1.076
Mining revenue sharing/capita	5128	0.131	0.656	0	22.065
Other revenue sharing/capita	5129	0.008	0.029	0	0.721
General purpose transfer (DAU)/capita	5130	0.690	0.920	0	21.326
Tax sharing transfer/capita	5130	0.095	0.243	0	9.615
Special allocation transfer/capita	5130	0.084	0.164	0	4.259
Real RGDP /Capita	5131	7.600	13.267	0.347	270.80
Trade, hotel and restaurant (share of Real RGDP)	5114	0.176	0.084	0	0.478
Literacy rate (%)	4941	90.953	10.211	10.93	99.92
Population in urban area (%)	4940	35.986	31.918	0	100
Poverty rate (%)	4732	17.076	9.844	1	61
Household access to electricity (%)	4525	83.354	20.762	0	100

Note: All fiscal and economic variables are measured in million rupiah in constant 2000 term and per capita term.

The own revenue per capita consists of local tax and retribution revenue and a zero value shows the unavailability of data, particularly for new districts. The lowest value of mining revenue sharing is zero indicating that some districts do not receive revenue sharing from the mining sector, such as districts in Bali province. The zero figures in the percentage of population in urban areas and household access to electricity indicate the absence of data. Figure 2-7 shows the result of a scatter plot graph between the two variables of interest, mining revenue sharing and local own revenue (tax and retribution). It can be observed that the dots in the scatter plot do not show a pattern of movement of correlation. The flat fitted line reveals the absence of correlation. This pattern gives a preliminary indication that there is no relationship between these two variables. Further, the correlation score is only 0.0138 suggesting the absence of correlation between the two variables.

Figure 2-9 **Scatter plot of shared mineral revenue and OSR**



Source: Author's calculation from STATA. Figure is in log.

2.4.2 Methodology and estimation model

The own-source revenues collected by districts comprise taxes, charges and other types of revenue. As mentioned in the previous section, other revenue includes local government revenue obtained from local government-owned enterprises and separate local government wealth, and other revenue sources, including deposit interest. Among the types of own revenue, local taxes and retribution require well-designed, proactive fiscal policies, to ensure potential local tax retribution revenue is collected. Other types of own revenue only require supervisory policies from local government to ensure potential revenue distribution for local government. Against this background, this study only examines local revenue from local tax and retribution.

Previous studies on the nexus between natural resource revenues and tax efforts at cross-country level employ the level of development (per capita of GDP), trade (imports and exports as a percentage of GDP) and education (public expenditure on education as per cent of GDP), inflation (CPI), income distribution (GINI coefficient), the ease of tax collection (agricultural sector value added as GDP percentage), and corruption (Fenochietto & Pessino 2014, see also Davoodi & Grigorian 2007; Gupta 2007; Le, Dodson & Bayraktar 2012). Dioda (2012) extends the determinants by including social and political factors including civil liberties, female labour force participation, the age composition of the population, the degree of political stability, the level of education, and population density, as well as the size of the shadow economy. Crivelli & Gupta (2014) investigate the impact of natural resource revenue by employing foreign debt to GDP and foreign aid as control variables in addition to GDP per capita, corruption, agriculture share in GDP, inflation and non-resource openness. Following cross-country studies, this study uses some macroeconomic variables, including regional gross domestic product and price level.

Previous studies (Mahdavi 2008; Chaudhry & Munir 2010) argue that widespread literacy in society is essential to efficiently generating tax revenues, for example, personal income, small business profits, and capital gains as well as domestic trade as at facilitates tax compliance and collection. The wider literacy rate enables citizens to understand tax regulations, which promotes higher tax compliance. In addition, a wider literacy rate plays an important role in promoting tax revenue through reducing tax evasion. Book (2003) finds that literacy becomes a channel for deviant taxpayers to hide their tax evasion. By consequence, an increase in literacy tends to eliminate this kind of evasion. Therefore, this paper uses the literacy rate for adults over 15 years as a control variable for local own revenue.

Literature about determinants of local government own revenue finds that intergovernmental transfers play an important role in local own revenue variation. Fiscal grants are aimed to minimize horizontal inequality and help to finance sub-national spending. However, some previous studies show the disincentive effect of equalization grants on local tax efforts, creating fiscal dependence at the sub-national level. Mogues & Benin (2011) examine Ghana's districts' local public finances over 11 years, finding that intergovernmental and other transfers to local governments discourage the collection of internally generated revenues and funds. Liu & Zhiao (2011) find that fiscal transfers and equalization grants are negatively correlated with local provincial tax efforts in China. Other previous studies also find negative correlations between local tax efforts and intergovernmental transfers (see Panda 2009; Bacarreza & Espinoza 2010). Given the important role of other types of intergovernmental transfers, I include tax-revenue sharing, special allocation transfers, general purpose grants and forest revenue sharing as additional explanatory variables.

For the case of Indonesia, a few studies on the impact of intergovernmental fiscal transfers on local government performance have shown mixed results. Fadliya and McLeod (2010) argue that the general purpose grant (DAU) formula demotivates local own-source revenue mobilization, because each additional rupiah collected will be fully offset by an induced equal reduction in the total transfer entitlement. Shah et al. (2012) uses the year of 2010 only, finding a negative correlation between general purpose grants and local own revenue. They argue that the use of actual revenues in the formula, as opposed to potential revenues creates disincentive effects for own tax efforts. On the contrary, Lewis (2005) finds a positive association between fiscal transfers and local own revenue for the post-decentralization period. He argues that heads of local governments and DPRD expect their overhead expense budgets to grow as general

revenues grow. As a result, if central transfers increase, overhead budgets must increase as well. By law, routine local government overhead expenses must be funded out of own-source revenue. Therefore, as transfers increase, if overheads are also to increase, local taxes must rise. In the same line, Lewis and Smoke (*forthcoming*) split the types of fiscal transfer, and find that shared taxes and general purpose grants have positive effects on local own revenue.

RGDP per capita is used as a proxy for the level of a district's economic development, and it is expected to be positively correlated with the government's ability to collect taxes and the people's ability to pay them. The presence of THR (trade, hotel and restaurant) share of GDP is to show the local role of this sector. The increase in trade and number of hotels plays a crucial role for municipal own revenue since they are only eligible to collect the hotel and restaurant tax and government issued permits. The tax on hotels and restaurants is imposed on turnover at a rate of 10%. Therefore, higher turnover in this sector will lead to a greater revenue base for local own revenue from the hotel and restaurant sector. Hence, a greater share of hotel and restaurant turnover in the economy can contribute to greater own-source revenue.

The percentage of the population living in urban areas captures the urban character of districts' tax and retribution. Based on specific criteria, the statistics office divides the lowest government level (*kelurahan*) into urban and rural areas. The criteria include population density, urban facilities, and agricultural households. As the hotel and restaurant tax is one of the urban facility criteria, the more people reside in an urban area, the higher potential revenue from hotels and restaurants. Besides, more business offices are located in municipalities and cities.

The percentage of population in urban areas is only available for the years 2005 and 2010, the latest censuses. For the year 2001, urban population is estimated from the 2000 census.[6]

Another important determinant of local own revenue in Indonesia is the percentage of poor people. A higher proportion of poor people will lower local food consumption and impact restaurant tax revenue. I also include the percentage of household electricity access, where the street lighting tax plays an important role in local tax revenue composition.

This study employs unbalanced panel data of mineral-producing districts in Indonesia and applies a fixed effect approach for estimation. The idea of fixed-effects estimation is to investigate "within-district variation," that is, to investigate whether a district becomes more reluctant to enhance own-source revenues as it receives resource-revenue sharing. Each entity has its own time constant individual unobserved characteristics or heterogeneity that may affect the revenue efforts. The existence of unobserved heterogeneity, including area size and district geography, would lead to omitted variables when the regression model does not take into account, and makes the estimators become biased and inconsistent (Wooldridge 2002, p. 50).

With fixed effects, it is assumed that unobserved heterogeneity variables are correlated with other explanatory variables. Geographical factors, such as area size, are constant, and correlated with grant size. The district's location factor, mountainous area and beachfront area will be related to special transfer allocations, such as fishery and

[6] I use *Urban Rural Growth Difference approach* to estimate the urban population percentage for other relevant years with following formula (Bappenas et al. 2013):

$U' = \frac{T' + dR}{T} \times U$, Where U' = Urban population in year t+1, U = Urban population in year t, R = Rural population in year t, d = Urban Rural Growth Difference, T' = Total population in year t+1, and T = Total population in year t.

forestry special allocation transfer (DAK). This correlation may lead to potential endogeneity between unobserved variables and other relevant explanatory variables. The fixed effect removes the effect of time invariant unobserved variables, by differencing or demeaning, so that the estimation will result in the net effect of other explanatory variables on the dependent variable.

The linear estimation models will be used to estimate the determinants of tax efforts in mineral-producing districts in Indonesia as follows:

$$f_{it} = \gamma_0 + \boldsymbol{\gamma_1 MRS} + \boldsymbol{\gamma_2 X_{it}} + \rho_t + \boldsymbol{\alpha_i} + \varepsilon_{it} \qquad (2)$$

The dependent variable (f_{it}) represents total own revenue from local tax and retribution, which is defined in log of real per capita. The mining revenue sharing per capita (MRS) is the variable of interest. The vector of **X** represents the control variables including other resource-revenue sharing (forestry and fishery) per capita, other types of fiscal transfers per capita (general purpose grants, shared tax and special purpose transfers), RGDP/capita, the trade, hotel and restaurant/RGDP, percentage of adult literacy rate, percentage of people in urban areas, poverty rate and percentage of household electricity access. α_i denotes district fixed effects or districts' unobserved heterogeneity, ρ_t represents the time fixed effect which accounts for government policy changes which may affect revenue efforts. ε_{it} is an error term capturing all other omitted factors, with $\mathbf{E}(\varepsilon_{it}) = 0$ for all i.

Based on the argument developed in the previous section, natural resource revenue does not discourage local own revenue collection when local government does not have control over natural resource revenue collection[7]. Therefore, the primary hypothesis of this study is that natural resource revenue does not become a disincentive for local own revenue mobilization. Besides, different types of natural resources may have different impacts on sub-national own revenue as previous studies suggest. I postulate the following hypotheses:

HP-1: Shared mining revenue does not discourage sub-national revenue efforts in mineral-producing districts

HP-2: Other types of intergovernmental transfers discourage sub-national revenue efforts in mineral-producing districts.

2.4.3 Empirical results discussion

The first estimation uses all districts to obtain general hints about the impact of mining revenue on non-resource revenue for all districts in Indonesia. The next step is to split the districts into mineral and non-mineral-producing districts with the purpose of testing arguments developed in the previous section. Table 2-7 presents the econometric estimation result with robust error fixed effect[8].

[7] Under article 17 of Law No. 18/2004 on Estate Crops ore, local leaders have the authority to issue permits for estate crop and mining businesses investment for certain area size in their jurisdiction. This authority is solely the extension of central government's authority and central government can revoke the licences when they do not meet the requirements. Further, the calculation of mining sector revenue is based on previous year realization and takes into account the projected global economic conditions which are exercised by the Ministry of Energy and Resources. Every fiscal year the mining permit holder provides production prognoses for estimating mining revenue. Hence, the authority in issuing licence does not necessarily grant power for local governments to increase production.

[8] Hausman test between fixed and random shows significant chi2 value= 217.34, which is statistically significant. This suggests the significant difference in coefficients between fixed and random model. Hence, fixed effect is preferred for the estimation.

Table 2-7 **Panel data results with fixed effects**

Dependent variable: Total own revenue/capita	District and time Fixed effect with robust standard error		
Independent variables:	All districts	**Mineral-producing**	Non mineral-producing
Mining resource-revenue sharing/capita	**-0.0008 (0.0079)**	**0.003 (0.0113)**	**0.001 (0.010)**
Other natural resource revenue /capita	**0.027 (0.019)**	**0.027 (0.025)**	**0.038 (0.026)**
General purpose transfer (DAU)/capita	**0.123*** (0.044)**	**0.145** (0.059)**	**0.075 (.059)**
Tax sharing transfer/capita	**-0.019 (0.023)**	**0.015 (0.027)**	**-0.112** (.044)**
Special allocation transfer/capita	**0.024** (0.011)**	**0.027** (.0137)**	**0.008 (0.018)**
RGDP /capita	0.196** (0.093)	0.136 (0.111)	0.344** (0.162)
Trade, hotel and restaurant (share of Real RGDP) (%)	0.127 (0.086)	0.131 (0.097)	0.077 (0.134)
Literacy rate (%)	0.238* (0.144)	0.638 (0.553)	0.229* (0.120)
People in urban area (%)	0.034 (0.037)	0.060 (.0419)	-0.087 (0.065)
Poverty rate (%)	-0.024 (0.064)	-0.034 (0.109)	0.045 (0.075)
Household access to electricity (%)	0.096 (0.101)	0.080 (0.118)	0.139 (0.191)
Number of population	-0.267 (0.191)	-0.353 (0.241)	-0.111 (0.308)
R^2 within	0.20	0.22	0.20
Time fixed	Yes	Yes	Yes
Number of observations	3291	2118	1174
Number of groups	544	357	187

Note: All variables are in logarithmic terms. The dependent variable is total own revenue comprising local tax and retribution only. All fiscal and economic variables are measured in real per capita terms. Figure in bracket is standard error. The signs ***, **, and * indicate significance at 1, 5, 10 per cent respectively. RGDP per capita is million rupiahs.

All districts

All estimation specifications use time fixed effect (two way fixed effect) with the purpose of capturing temporal variation in local own revenue resulting from policy improvements by local governments. Besides, the increase in local people's awareness over local government accountability and transparency will drive improvement in local revenue performance.

For all districts in Indonesia, this study does not find evidence that natural resource-revenue sharing negatively affects local own revenue efforts. This estimation is for both mineral-producing and non-producing districts. The other natural resource-revenue

sharing (forestry and fishery) and tax sharing do not correspond with local tax and retribution collection[9]. On the other hand, overall general allocation grants are strongly correlated with local own revenue. Because all variables are in logarithmic form, the coefficient can be read as every 1 per cent increase in general allocation grants, other variables being constant, leads to more than 0.1 per cent increase in local own revenue. Although previous studies argued there were potential disincentive effects of general allocation grants on local own revenue (Shah et al. 2012; Fadliya & McLeod 2010), this finding shows no evidence of disincentive effects. One potential argument that may explain this finding is that own-source revenues serve as an important secondary source of funding for local salaries and allowances, that is, above and beyond those from general purpose grants, and this might be one reason why own-source revenues increase hand in hand with DAU (Lewis and Smoke *forthcoming;* Lewis 2005).

It is plausible to expect a negative correlation between shared tax revenue and local own revenue. Income tax and property tax make significant contributions toward local revenue. The infrastructure for these taxes is already mature, and local governments only assist the central government in tax collection. With a greater tax base, local governments would prefer to actively assist in income and property tax collection and retain their local own revenue potential. Although, the general hint from fixed effect estimation on all districts supports the argument of disincentive effects of tax sharing transfer, the effect is insignificant. In the same vein, it is reasonable to argue the disincentive effect of special allocation grants on local own revenue mobilization. Local governments might consider lowering their local revenue efforts when special allocation transfers cover their spending needs. As the purpose of special allocation transfer is to assist local government spending in specific activities, this transfer helps to close financing gaps of the specific activities and reduce the need to explore more own

[9] Tax sharing revenues comprise those from property tax and the personal income tax.

revenues. Unlike shared tax revenue, special purpose transfers (DAK) promote more local own revenue in local governments in Indonesia.

The estimation undertaken for all districts shows that real GDP per capita has a statistically significant positive correlation with local own revenue. The estimator coefficient implies that every 1 per cent higher RGDP per capita is correlated with almost 0.2 per cent higher local own revenue per capita, which takes the form of local tax and retribution. In other words, a bigger district economy size leads to higher potential revenue from local tax and retribution. The total output from the trade, hotel and restaurant sectors, which serves as one important tax base, does not statistically significantly contribute to local own revenue.

The all district estimation finds that overall literacy rates significantly contribute toward promoting local own revenue efforts, although only at a 10% level of significance. The number of people in urban areas and poverty rates do not statistically correspond with local own revenue, although the coefficient sign supports the reasoning underlying these variables. Household electricity access, as an important tax base for local own revenue, does not promote local own revenue efforts although the coefficient sign is positive as expected.

Mineral-producing and non-mineral producing districts

The estimation results based on the classification of districts based on mineral production also shows generally similar results to the all districts sample. In mineral-producing districts, the main focus of this study, the impact of resource revenue on non-resource revenue appears muted. The econometric estimation finds evidence that shared mining revenue does not become a disincentive for local revenue efforts as suggested by arguments in the previous section. The allocation of natural resource-revenue sharing follows the nationally regulated percentage. Hence, it is obvious that districts with

mineral resource abundance receive higher amounts of resource revenue. However, these districts cannot increase their natural resource-revenue sharing at their discretion. In Indonesia's case, although central government needs to consult with mineral-producing local governments beforehand, the natural resource policies are still managed by central government. The tax rate or tariff is a domain of the Ministry of Finance and the Ministry of Energy and Resources. The tax base and mineral (oil and gas, and coal) production are under the domain of the Ministry of Energy and Resources. Therefore, this revenue is exogenous as it is outside the control of local governments, under present legal and administrative arrangements (Lewis 2013). Under this arrangement, local governments cannot substitute local own revenue for natural resource revenue when they suffer from budget deficits. Nevertheless, other external factors, such as higher mineral product prices, will increase mining revenue sharing. This estimation also finds no evidence of a disincentive effect of mining revenue sharing in non-mineral-producing districts[10].

Similar to all district estimation, other natural resource-revenue sharing (forestry and fishery) does not depress local own revenue in either mineral or non-mineral-producing districts. General purpose grants and special allocation transfers play an important role in greater collection efforts of own-source revenue in mineral-producing districts only, but are statistically insignificant in non-mineral-producing districts.

The shared tax has mixed effect on local own revenue. The impact is insignificant in mineral-producing districts but statistically significant in non-mineral-producing districts, with a negative effect. Although the previous section elaborated the argument of negative effects of shared tax on local revenue, the different potential tax base between the two types of districts may provide a plausible explanation. The urban

[10] Districts (*kabupaten* and *kota*) in the mineral-producing provinces are entitled to obtain certain allocation of mining revenue sharing.

character plays an important role in determining shared tax revenue. There are 18 municipalities in mineral-producing districts and 74 municipalities in non-mineral-producing districts. The higher value of property in city areas results in higher property tax and provides greater revenue for local government. Therefore, property tax revenue is higher in non-mineral-producing districts and depresses own-source revenue efforts in this group of districts. The special purpose grants (DAK) are positively correlated with own-source revenue in mineral-producing districts only.

The RGDP per capita is an important tax base for promoting local own revenue. The higher standard of living may lead to higher purchasing power by local government, and boost demand for locally taxable objects. However, the correlation is only significant in non-mineral-producing districts. Although the average size of RGDP per capita in mineral-producing districts, accounting for almost 8 million rupiahs per capita, is greater than in non-mineral-producing districts accounting for 6.8 million rupiahs per capita for, this different effect may reflect the high poverty rate in mineral-producing districts. The average poverty rate in mineral-producing districts for the period of 2001–2012 was 17.8 per cent, which is higher than in non-mineral-producing districts where it was 15.8 per cent. Hence, one plausible explanation regarding the insignificant effect of RGDP per capita in mineral-producing districts is that the natural resource endowment does not necessarily lead to poverty reduction (Ilmma & Wai Poi 2014). In the same vein, Bhattacharyya and Resosudarmo (2015) find that growth in non-mining sectors significantly reduces poverty and inequality. In contrast, overall growth and growth in the mining sector appears to have no effect on poverty and inequality. Unlike in mineral-producing districts, the coefficient of poverty rate in mineral-producing districts is negative, as expected, but the effect is not statistically significant. In other words, GDP per capita does not translate into lower poverty in mineral-producing districts.

This study also carries out a further analysis on mineral-producing districts based on the mineral resource endowment. This aims to investigate whether there is a different pattern of disincentive effects between rich and non-rich mineral-producing districts (see Lewis 2005). This paper uses the average value of total shared mining revenue per capita of 0.13, or 130.000 IDR per capita, as the threshold of rich and non-rich districts. The greater mining resource-revenue sharing a district receives reflects the high mineral endowment it possesses. To ensure consistency, each district's average mining revenue is compared to average mining revenue sharing for all mineral-producing districts. Districts with averages higher than the threshold are classified as rich mineral-producing districts, and those with average mining revenue sharing lower than the threshold are grouped into non-rich mineral-producing districts. The different sizes of natural resource endowments may bring about different effects of mining revenue on local own revenue. Table 2-8 presents the estimation results of natural resource revenue effects on local revenue efforts by districts' mineral endowment.

Table 2-8 **Time and district fixed effect- resource wealth size classification (robust error)**

Dependent variable: Total own revenue/capita	Mineral rich producing districts		Non-mineral rich producing districts	
Independent variables:	Coefficient	Standard error	Coefficient	Standard error
Mineral revenue sharing/capita	-0.070	(0.055)	0.009	(0.010)
Other natural resource revenue /capita	-0.009	(0.049)	0.064**	(0.028)
General purpose transfer (DAU)/capita	0.147**	(0.057)	0.086	(0.099)
Tax sharing transfer/capita	0.004	(0.042)	0.026	(0.036)
Special allocation transfer/capita	0.027	(0.022)	0.008	(0.015)
RGDP /Capita	0.115	(0.262)	0.126	(0.124)
Trade, hotel and restaurant (share of Real RGDP)	-0.260	(0.260)	0.196**	(0.068)
Literacy rate (%)	2.310*	(1.186)	-0.010	(0.673)
People in urban area (%)	0.102	(0.069)	0.021	(0.043)
Poverty rate (%)	0.175	(0.109)	-0.292*	(0.160)
Household access to electricity (%)	-0.066	(0.208)	0.238*	(0.144)
F-test	4.51***	n.a	13.44***	n.a
R^2 (within)	0.18	n.a	0.27	n.a
Time fixed	Yes	n.a	Yes	n.a
Number of observation	647	n.a	1471	n.a
Number of groups	108	n.a	249	n.a

Note: Figure in bracket is standard error. The signs ***, **, and * indicate significance at 1, 5, 10 per cent respectively. RGDP per capita is in million rupiahs.

The estimation over mineral rich and non-rich districts generally results in practically similar results with previous estimations. The impact of shared mining revenue on local own revenue is muted, which is consistent with the arguments developed in this study. The impact of general purpose grants on local own revenue is only positively statistically significant in rich mineral-producing districts. Special allocation transfers are only significant in rich mineral districts. The split of mineral-producing districts based on resource wealth gives interesting results, where the important tax bases, trade, hotel and restaurant and street light taxes (percentage of household access to electricity) are only positively significant in non-rich mineral-producing districts. There are at least two reasonable arguments that may explain the muted role of the trade, hotel and restaurant sector on local own revenue. Firstly, the lack of technical and administrative capacity of local tax agencies undermines local tax collection. In Jakarta, the nation's capital, only about 41% of registered hotel, restaurant, and entertainment industry

taxpayers actively remit sales tax every month (ADB 2015). Low voluntary compliance is exacerbated by local tax regulations that impose a heavy burden or high compliance costs, and contributes to low local own revenue. The low institution quality of local tax agencies, including outdated information systems, has hampered better local tax collection. Secondly, possible income underreporting from businessmen in this sector, in particular small individual hotel and restaurant businesses, reduces tax collection. The difficulty in obtaining true income figures from individual taxpayers has been a longstanding issue in Indonesia tax authorities, which particularly results from income underreporting. Further, local governments need to ensure that the state-owned electrical company (PLN), as a tax withholder, collects all potential street light taxes.

2.4.4 Why is the tax effort suboptimal in mineral-producing districts?

The econometric estimations in the previous section point out that the significant shared natural resource revenue in both types of group is not associated with variation in own-source revenue. However, the average tax and retribution revenue per capita is higher in non-mineral-producing districts. The simple *t-test* in Table 2.9 shows significant different revenue differences between these two groups. The average tax revenue per capita in mineral-producing districts only accounts for 0.012 or IDR 12,000 per capita, which is much lower than in non-mineral-producing districts, accounting for 0.022 or IDR 22,000 per capita. The tax revenue over total economic turnover or tax ratio is 0.022 or 2.2% in non-mineral-producing districts, which is greater than in mineral-producing districts where it accounts for only 1.2%. The *t-test* also shows that the difference is significant. This figure suggests that non-mineral-producing districts are apparently more active in mobilizing tax revenue from their economic activities. The second explanation results from the level of poverty. The average poverty rate is greater in mineral-producing districts, implying lower economic activity, leading to a lower

revenue base. I investigate the impact of poverty on each type of revenue. The results are shown in Table 2.10.

Table 2-9 **Comparison of tax effort between groups (average value)**

Group	Tax per capita	Retribution per capita	Tax over GRDP (%)	Retribution over GRDP (%)	Poverty rate (%)
Mineral-producing districts	0.012	0.012	0.002	0.002	17.86
Non Mineral-producing districts	0.022	0.017	0.003	0.003	15.80
t- value	7.29***	12.37***	10.10***	15.28***	-7.01***

Note: RGDP is constant value at 2000 price.

The fixed effect estimation for each type of revenues (tax and retribution) consistently shows the absence of effects of shared natural resource revenue over tax and retribution, as shown in Table 2-10. However, this estimation provides evidence that poverty has a negative effect on retribution revenue, although only at the 10% level of significance, but not for tax revenue. The estimation for mineral-producing districts also shows a consistent negative effect of poverty over retribution[11].

[11] The estimation of non-mineral-producing districts shows the absent role of poverty over both tax and retribution.

Table 2-10 **Estimation on each type of revenue**

	All districts		Mineral-producing districts only	
Independent variables	Tax per capita	Retribution per capita	Tax per capita	Retribution per capita
Mining Resource-revenue sharing/capita	-0.004 (0.007)	-0.0003 (0.010)	-0.010 (0.012)	0.018 (0.014)
Other natural resource revenue /capita	0.021 (0.019)	0.0120963 (0.026)	0.027 (0.025)	-0.0004 (0.033)
General purpose transfer (DAU)/capita	0.118*** (0.032)	0.108** (0.052)	0.144*** (0.043)	0.120* (0.070)
Tax sharing transfer/capita	-0.002 (0.029)	-0.021 (0.032)	0.018 (0.037)	0.010 (0.039)
Special allocation transfer/capita	0.026* (0.012)	0.006 (0.015)	0.039** (0.015)	0.001 (0.018)
RGDP /capita	0.181 (0.142)	0.121 (0.146)	0.156 (0.187)	0.105 (0.183)
Trade, hotel and restaurant (share of Real RGDP) (%)	0.094 (0.115)	0.035 (0.113)	0.119 (0.124)	0.011 (0.132)
Literacy rate (%)	0.479* (0.250)	0.0378 (0.178)	0.530 (0.584)	0.247 (0.688)
People in urban area (%)	-0.041 (0.048)	0.0856 * (0.047)	-0.017 (0.057)	0.091 (0.053)
Poverty rate (%)	0.075 (0.048)	-0.180* (0.094)	0.108 (0.085)	-0.238* (0.141)
Household access to electricity (%)	0.063 (0.108)	0.253* (0.142)	0.215 (0.123)	0.117 (0.165)
Number of population	-0.041 (0.233)	-0.560* (0.216)	0.030 (0.308)	-0.636 (0.264)
F-test	40.08	11.21	25.86	10.01
R^2 (Within)	0.36	0.08	0.33	0.10
Time fixed	Yes	Yes	Yes	Yes
Number of observations	3290	3288	2117	2115
Number of groups	544	543	357	357

Note: All variables are in logarithmic term. All fiscal and economic variables are measured in real per capita terms. Figure in bracket is standard error. Figure in bracket is standard error. The signs ***, **, and * indicate significance at 1, 5, 10 per cent respectively. RGDP per capita is million rupiahs.

A study from Gamu et al. (2015) which reviews 52 studies on poverty and extractive industries finds that institution quality and the scope and modes of resource exploitation affect the scales and mechanisms through which extractive industries influence poverty. Although poverty is not necessarily associated with environmental destruction (see Purnamasari 2010), the high poverty rate in mineral-producing districts in this study suggests an urgent need to look into the current practices of the extractive industry in Indonesia, in particular its environment and social impacts.

2.5 Conclusion and policy implication

The own-source revenue from tax and retribution is lower in mineral-producing districts than in non-mineral-producing districts in Indonesia. Following the argument developed in this study, when shared mining revenue is exogenous, its impact on own-source revenue is muted. The important finding of this study supports the argument that shared mining revenue does not become a disincentive toward the collection of local own-source revenue in mineral-producing districts in Indonesia. The effect is found to be consistent for all specifications. In line with the arguments developed in this paper, mineral-producing district governments in Indonesia have very limited control over resource revenue assignment. Under this mechanism, local governments of mineral-producing districts are not able to substitute own-source revenue for shared mining revenue. Therefore, regardless of the amount of mining revenue through revenue sharing, it will not depress local own-source revenue efforts.

Although the main finding suggests that natural resource endowment does not necessarily become a disincentive for fiscal performance, the higher poverty rate in mineral-producing districts should become a focus of attention. The higher poverty rate in mineral-producing districts has contributed to the lower own-source revenue. The literature has shown a strong linkage between the lack of institution quality in the extractive sector and poverty. This suggests the need to revisit the supervision and regulation of the extractive industry in mineral producing districts in Indonesia and to ensure that this sector implements more sustainable mining practices.

3. TESTING SPATIAL INTERACTION OF ENVIRONMENTAL SPENDING AMONG LOCAL GOVERNMENTS IN SUMATERA AND KALIMANTAN ISLAND, INDONESIA

Abstract

Fiscal decentralization in Indonesia comes with the devolution of authority for environmental management to local governments. However, previous studies have shown that environmental policy can become one channel of spatial strategic fiscal interaction, resulting in spending spillover. The presence of spending spillover can result in divergence between private and social benefits, and thus lead to non-optimal spending decision making. Using district level data for the period of 2009–2012, this study empirically investigates the presence of spatial interdependence of environmental spending among local governments in Sumatera and Kalimantan Island. This study finds strong evidence of positive spatial interaction through spending spillover, suggesting that a district will increase its own environmental spending in response to neighbours' environmental spending. This study argues that pollution spillover serves as a channel of interaction for negative spending externality. This study shows that environmental spending per capita in mineral and timber producing districts is not systematically different from non-mineral and timber producing districts; suggesting a lack of environmental spending to optimally overcome the environmental impact due to natural resource exploitation. The lack of environmental spending in mineral and timber producing districts makes these districts unable to overcome the environmental consequences effectively. It worsens environmental problems and adversely affects its border-sharing neighbours; forcing neighbouring districts to increase environmental spending to counteract the adversely impacted environment, and to increase health spending.

3.1 Introduction

In many developing countries, environmental degradation has imposed significant costs over economic development, equivalent to 3–10 per cent of GDP (see the World Bank 2012). For Indonesia, the total cost of environmental degradation, including climate change, is over 5 percent of GDP per year and likely to increase (the World Bank 2009). Yet environmental degradation not only has adverse impacts on economic development, but also puts a burden on social and health costs. Rigorous public policies aimed to protect and preserve the environment are needed to ensure the achievement of more fruitful economic development.

Environmental problems, such as air pollution, coastal water pollution and deforestation, have national impacts, but their nature is locally specific. Hence, local government intervention is required to overcome this issue. The economic dividend of devolution through fiscal decentralization can result in more efficient outputs to local communities because local government can cater to local residents' preferences and needs (Rodriguez & Sandall 2008; Brennan & Buchanan 1980). As local governments have better knowledge of local environmental problems, they can address the problems more efficiently.

Since the introduction of fiscal decentralization in 2001 in Indonesia, the role of local governments has become more important and significant in environmental protection efforts. Through broader fiscal authority devolution and fiscal transfer, local governments can provide greater public expenditure for better public service, in particular environmental conservation services. The provision of conditional and non-conditional grants to local governments is expected to help provide better public expenditure, in particular environmental expenditure. Nevertheless, the environmental spending portion of total expenditure is very low, averaging 1% of total spending. The

lack of expenditure will not only undermine efforts to conserve the environment, but in greater scope, the efforts to mitigate climate change will be weakened.

Despite the benefits, some previous studies argue that decentralized environmental policy will result in a race to the bottom, the relaxation of environmental standards to attract investment (Esty & Geradin 1998). This situation particularly occurs when local governments inefficiently lower tax rates and consequently reduce spending to less than would be required for welfare maximization (see Wilson 1999). In addition to tax competition, trans-border pollution problems are considered to result in inefficiently weak environmental policies at the local level (Ulph 2000). Trans-border pollution occurs when a jurisdiction takes benefit from its neighbours by doing 'environmental dumping' when central government's intervention is absent. The literature has recognized this interaction among governments or spatial interaction in determining fiscal policies. Revelli (2003) argues that a local government's spending function is affected by spending somewhere else, or in neighbouring governments. A study from Fredriksson and Millimet (2002) finds some US states use strategic behaviour in setting their environmental policies.

The literature reviews of spatial interdependence by Brueckner (2003) and Revelli (2005) indicate that fiscal decisions in neighbouring jurisdictions tend to play a prominent role in decisions on tax rates or the level of public goods provision at local government level. In other words, there exists an expenditure spillover. Theoretically, the presence of fiscal spillover can result in divergence between private and social benefits, and thus lead to non-optimal fiscal decision making (Dahlby 1996). Therefore, it is important to understand how spatial interdependence, when it exists, affects a local government's fiscal behaviour. This study aims to investigate whether local governments in Sumatera and Kalimantan behave strategically in making environmental

spending decisions. Specifically, this study aims to investigate whether local governments in Sumatera and Kalimantan behave strategically in making environmental spending decisions. This study focuses on districts in Sumatera and Kalimantan. These two islands share similar characteristics, are rich in natural resources and suffer from environmental degradation (FWI 2014).

Studies on spatial independence and environmental spending are limited in the literature. Some of the few are recent studies from Deng et al. (2012) and Statsna (2009). However previous studies aiming to examine environmental spending in Indonesia are absent. The contribution of this paper is twofold. First, it fills the public expenditure literature gap by analysing the behaviour of local governments toward environmental spending. Second, it provides insights for policy makers about environmental policies at local level for these islands, and for Indonesia in general.

This paper is organized as follows. Section two provides theoretical background and a literature review regarding decentralized spending. The third section discusses some facts about decentralization and the environment in Indonesia. Section four focuses on data and methodology and is followed by interpretation discussion. Section five wraps up and provides policy implications.

3.2 Literature review

The basic idea of fiscal decentralization is that central governments have limited capacity to provide optimal public services to their citizens due to differences in particular preferences and circumstances of their constituencies. By decentralizing the provision of goods and services to local governments, the outputs of such goods and services will increase economic welfare above that provided by central government (Oates 1999). The local government can efficiently provide public goods which match citizens' preferences and needs, and government resource allocation will be more

efficient, because local governments are better informed about diverse local preferences than national governments (see Oates 1999; Tiebout 1956). By assuming a benevolent government, this line of argument is known as the first-generation theory of federalism (see Qian & Weingast 1997).

The studies under the second-generation theory of federalism examine the workings of fiscal decentralization with different political and fiscal institutions, particularly the fiscal and political incentives facing sub-national officials (Weingast 2009). The second generation treats governments as non-benevolent because they have goals induced by political institutions that often diverge from maximizing citizen welfare. One line of argument under the second generation is from Brennan and Buchanan (1980), who coined the usage of the term "Leviathan" for a revenue-maximizing government. They argue that emigration poses restrictions on the ability of government to exploit taxes. Therefore, a decentralized fiscal system through smaller government levels is one way to limit governments' excessive taxing power and to introduce fiscal competition among them, and thus pushes local governments to supply public goods efficiently.

To support the implementation of decentralized public services at the sub-national level, some types of spending and revenue are devolved to local governments. However, the devolution of spending responsibilities does not necessarily go hand in hand with the devolution of taxing responsibility, where in many cases the devolution of expenditure power is more substantial than taxing power (Dziobek et al. 2011). When fiscal transfer does not appropriately address the mismatch between revenue means and expenditure needs, this will result in a vertical fiscal gap (Shah 2007)[12]. Four causes can give rise to vertical fiscal gaps: inappropriate assignment of responsibilities, centralization of taxing

[12] Vertical fiscal imbalance is mistakenly used interchangeably with vertical fiscal gap. A situation where vertical fiscal gap is not adequately addressed by the reassignment responsibilities or by fiscal transfer or by other means is called vertical fiscal imbalance (Shah 2007).

powers, pursuit of beggar-thy-neighbour tax policies (wasteful tax competition) by sub-national governments, and lack of tax room at sub-national levels due to heavier tax burdens imposed by the central government (Shah 2007). Besides, different characteristics across sub-national governments, including natural resource endowment and demography, result in disparities in fiscal resources at the sub-national level leading to horizontal fiscal imbalance. Among other purposes, intergovernmental fiscal transfers are frequently used to address both vertical and horizontal fiscal gaps, commonly called equalization transfer. This equalization aims to fill the gap to ensure sub-national levels of government can increase spending efficiency. Fiscal transfers can be used to correct biases in state governments' decisions resulting from fiscal externality. Through this, central government provides compensation for the benefit spillover.

3.2.1 Fiscal transfers and local government spending

Intergovernmental fiscal transfers are not only intended to help local government public service financing, but central government can use them as strategic tools to achieve diverse objectives, including dealing with providing compensation for benefit spillover, and influencing sub-national policies in taxing, spending, and regional and local economic stabilization (Gamkhar & Shah 2007). However, the fiscal decentralization literature has documented several anomalies in local government spending behaviour. Previous studies have found that the availability of external financing sources, including from borrowing and fiscal transfers, can adversely affect local government fiscal behaviour. Commonly known as soft budget constraint, this reflects opportunistic behaviour of local officials to inflate spending while expecting higher levels or central government to cover additional unnecessary expenditure (Prud'homme 1995). Hence, this behaviour potentially undermines fiscal discipline in lower level governments.

Some empirical studies have shown that a dollar of general purpose grants leads to significantly greater public spending than an equivalent dollar of citizens' income, or which is called the flypaper effect (Inman 2008). One of the arguments to explain the flypaper effect is the existence of substitution and price effects from fiscal transfers (Hamilton 1983). He suggests that the flypaper effect is due to the fact that unconditional grants constitute additional income. The increased income due to fiscal transfers results in a substitution effect for purchased inputs. The price of the output falls with increased endowment of the input income. This price reduction stimulates demand for the output, which in turn stimulates demand for the purchased input. In the same line, Hamilton (1986) argues that grant-financed expenditures have lower costs than tax-financed expenditure. Therefore, a local government will promote higher spending financed from grants.

Another problem which has been discussed in the literature is what is called the common pool problem. This may occur where sub-national governments do not internalize the full cost of local expenditure and tend to overspend or lower their tax efforts. This results from local public expenditures which come partially from taxes collected from residents outside the jurisdiction, which incentivizes local governments to spend more than they would when using their own tax revenues (Stein 1999).

The literature has also identified that tax competition to attract mobile capital leads local governments to inefficiently lower tax rates and reduce spending to lower than would be required for welfare maximization (see Wilson 1999). Such competition may motivate local governments to provide growth-promoting infrastructure and not to offer socially inefficient services (Qian & Roland 1998).

3.2.2 Spatial interdependence of local government spending

Interaction among economic agents is considered an important part in the decision-making process. There are three types of interaction among economic agents (Mansky 2000): (i) constraint interactions, a situation where an economic agent will consider the decisions of other agents in a situation of shared common resources, (ii) expectations interactions, where an economic agent makes a decision by drawing lessons from observing the actions chosen and outcomes experienced by other agents, and (iii) preference interactions, which occur when an agent's preference ordering of the alternatives in a choice set depends on the actions chosen by other agents. Social interaction among economic agents leads to a situation of similar economic behaviour among members of the same group when they have similar individual characteristics or face similar institutional environments; this situation is called correlated effect (Mansky 2000).

Broadway (2001) elaborates in his paper that the decentralization of fiscal responsibilities entails various spillover costs, or fiscal externalities. These fiscal externalities take three main forms: (i) fiscal inefficiencies and inequities, (ii) horizontal externalities, (iii) vertical fiscal externalities. Fiscal inefficiencies and inequities arise when regions have different capacities to provide public services. The difference in net fiscal benefit creates fiscal incentives for firms and households to relocate (fiscal inefficiency) and fiscal inequities for those who stay in the region.

Horizontal fiscal externalities arise from tax and expenditure competition, and occur at the same level of government. This interaction can take both positive and negative form, in the sense that it can provide an incentive for sub-national governments at the same level to set too high or too low a level of taxes and/or expenditure size. However, the presence of horizontal fiscal externalities can distort the allocation of resources, leading

to inefficiencies across the economy. Positive fiscal externalities arise when a region's public service provision has beneficial effects for other regions, leading these other regions to lower their public service provision and reallocate the spending to other needs. Conversely, when a region's public policy bring harm to other regions and forces the other regions to utilize extra fiscal policies, including higher spending, this spillover is called negative externality.[13]

Vertical externality arises when the fiscal externality effects involve different tiers of government. Rivelli (2003) explains that vertical fiscal externalities can arise for three main reasons, (i) tax base sharing between different tiers of government, (ii) the lower demand provided by other levels of government due to increases in tax rates, (iii) the nature of public services provided at different levels of government, whether they be complements or substitutes for different level tiers of government.

The strategic interaction between governments can be explained by two frameworks, spillover and resource-flow models (Brueckner 2003). Under a spillover framework, there are two channels of strategic interaction among local governments, expenditure spillover and yardstick competition. In their paper, Case, Hines and Rosen (1993) argue that there is another important determinant of state and local government spending, that is, the spending of neighbouring jurisdictions. A local government may mimic fiscal policies of other local governments with similar situations. They emphasize the presence of spatial dependence and find strong empirical evidence in support of the mimicry hypothesis, which suggests the correlated hypothesis as argued by Mansky (2000). The spillover or externality occurs where public expenditure of a jurisdiction generates beneficial or negative effects that pass across its boundaries. The second

[13] It should be differentiated between positive externality and positive spatial pattern. When the affected jurisdictions benefit from a jurisdiction's spending, there exists positive externality. However a positive spatial pattern occurs when a jurisdiction must exert greater spending since neighbouring jurisdictions inflict negative externality on its spending.

channel is the presence of yardstick competition (Besley and Case 1995). This model argues that imperfectly informed citizens in a jurisdiction compare the performance of other governments as a comparison or yardstick to evaluate their own governments. Consequently, an informed government will mimic fiscal policies of neighbouring jurisdictions in order to be re-elected.

The second type of strategic interaction framework refers to what is called a resource-flow model. Under this framework, strategic interaction occurs through the existence of particular shared resources. There are two channels that fall into this framework, tax competition and welfare competition. This hypothesis suggests tax competition might occur if local governors compete with their neighbours to attract households or firms and a mobile tax base (Revelli 2003). When the jurisdiction reduces the tax rate to attract mobile capital, expenditure will be adversely affected, leading to what is called the race to the bottom hypothesis.

Under welfare competition, a jurisdiction strategically chooses benefit levels, taking into account the targeted community. When a jurisdiction attempts to avoid in-migration of poor people, a low benefit level will be provided. In principle, the idea of these models originate from Tiebout's hypothesis that individuals "vote with their feet", where people or voters will move to a community that matches their desired level of public goods.

To complement the spatial interaction literature, Statsna (2009) argues that fiscal interaction among local governments can be explained through cooperative and non-cooperative behaviour. The main sources of strategic interaction in the non-cooperative setup are spillovers, fiscal competition and yardstick competition. Cooperative behaviour among local governments can be undertaken through joint projects, such as jointly financed infrastructure, recreational services, and environmental protection.

Hence, cooperative behaviour has a positive effect of spatial interdependence among cooperative local governments.

The types of expenditure which have externality effects include infrastructure spending, environmental protection and education spending. A jurisdiction with better environmental quality will create a positive spillover to its neighbouring jurisdictions. The strategic interaction is that the benefiting jurisdictions will free-ride and reduce their environmental efforts or spending because this spending has been partially covered by another jurisdiction; they can then reallocate resources to different spending. Nevertheless, positive spillover can occur when a jurisdiction's high infrastructure spending results in environmental consequences, and the affected neighbouring jurisdictions are forced to exert higher environmental efforts. The positive or negative correlation of intergovernmental activities as a result of spillovers depends on the complementarity and substitutability of the spending. When a local government can reduce its spending due to its neighbours' spending, then the spending is classified as substitute. Conversely, when neighbour's spending causes greater spending, then the spending interaction is treated as complementary. The externality effect may also involve imitation behaviour. Better parks and amenities in one jurisdiction may induce similar expenditure in other jurisdictions.

Previous studies examining spatial relations in environmental spending are limited in the literature. A recent study from Deng et al. (2012) uses city-level data in China and find that city governments behave strategically in making spending decisions regarding environmental protection. This paper finds that a city government appears to cut its own spending as a response to a rise in environmental protection spending by its neighbours. Revelli (2003) uses English data; he finds positive spatial patterns in environmental spending at district government levels in English local government. However, after

taking into account higher level government spending, the spatial pattern of environmental spending at district level is fading. Fredriksson and Millimet (2002) find strategic behaviour on the part of US states in setting their environmental policies. They find that states are "pulled" toward higher abatement costs by improvements by neighbours with already higher relative abatement costs, and are much less responsive to changes in states with initially lower abatement costs.

Since the main purpose of this study is to empirically investigate the presence and pattern of spatial interdependence in decision making on environmental spending among local governments in Sumatera and Kalimantan, the study adopts expenditure spillover as the underlying theoretical argument to explain potential spatial interaction in environmental expenditure. Brueckner (2003) also suggests that the spillover framework fits the environmental model.

As noted by Revelli (2007), under expenditure spillover models, the welfare of jurisdiction *i* depends apart from private consumption of residents c_i, a vector of the district's own characteristics $X_i = [x_i1, x_i2, \ldots]$, and is also affected both by its own expenditure for local public services (s_i) and on spending in a neighbouring jurisdiction $n(s_n)$:

$u_i = u[c_i (y_i, s_i, g_i), s_i, s_n, X_i]$;

where private consumption c_i also depends on income (y_i), on the level of public spending (s_i) and on the amount of fiscal transfer from central government (g_i). Depending on the type of spillover, s_n can either raise or diminish the marginal utility of own spending ($\partial u_i/\partial s_i$), therefore leading either to positive correlation for complementary public goods provided by jurisdictions *i*, or negative correlation for

substitute public goods.[14] Although the reaction function is that jurisdiction *i* can take either sign, the theory is silent about the sign and channel of expenditure in spatial interaction.

In spillover models, the benefit of neighbours' environmental spending will reduce own environmental spending, leading to negative spatial interaction. Free riding behaviour is the main factor of this behaviour. On the other hand, positive spatial interaction occurs when one jurisdiction's policies impose costs to its neighbours. In other words, a jurisdiction spends more funds to mitigate the environmental costs resulting from neighbours' environmental impact. Transboundary or pollution spillover can be a channel of positive spatial interaction in environmental spending.

A previous study with sample firms in China from Duvivier and Xiong (2012) shows that border counties are more attractive destinations for polluting firms than interior counties, and border county residents are more highly exposed to pollution. They argue that it could be very profitable for a firm to locate its plants on the border of multiple jurisdictions to avoid stringent environmental regulations. With regard to the nature of transboundary pollution, the neighbouring districts will be affected when environmental efforts are lax. In the same vein, Lipscomb and Mobarak (2015) provide evidence that counties behave strategically in deciding where and how much to pollute. Hence, river pollution increases between neighbouring jurisdictions due to pollution spillover.

[14] The positive or negative effect can also occur through districts' environmental and non-environmental expenditure policy. In the regression equation, the error term captures non-environmental expenditure policies. The positive interaction from non-environmental spending arises from the specific economic policies of neighbouring districts. When the neighbour promotes industry with lack of environmental standard and supervision of waste management, the polluted natural amenity will adversely affect the life of communities in other districts. Hence, the affected districts will be required to provide extra spending to recover this damage. The negative interaction can occur through greater awareness on environmental issues which refrain community from further environmental damage. Hence, the better preserved environment prevents the neighbouring districts from disbursing greater environmental spending.

Following Lipscomb and Mubarak (2015), pollution spillover will be greater when polluting firms exist in a neighbouring jurisdiction. Consider two districts, *i* and *n*, with one polluting sector (e). Pollution, P, is transboundary and depends on the total pollution in the two districts, a_i and a_n, and *c* is abatement cost. It is assumed that abatement cost is known and similar in the two districts. Thus, $P= a_i + a_n$ gives the total pollution level in the two districts as a function of the individual pollution levels, and total environmental spending is $c^*= ca_i + ca_n$. The environmental spending must be greater in districts where the polluting sector is located, or $ca_e > ca$ to cover additional pollution from the polluting sector, otherwise total environmental spending c* will be below the optimum level to cover the pollution cost. The below optimum total environmental spending results in pollution spillover and makes the neighbouring district bear the external pollution cost. The natural resource exploitation brings consequences toward environmental quality. A district hosting polluting sectors will face greater environmental consequences when the effort to mitigate this impact is insufficient. Greater ecological damage or pollution will also adversely impact neighbouring districts.

The positive interaction of environmental spending results from the own district's response to its neighbours' lack of environmental spending. Hence, a district may expend greater environmental spending to mitigate costs incurred due to pollution spillover. Previous studies have shown strong linkages between pollution and health conditions (see Resosudarmo 2003; Lelieveld et al. 2015). Air pollution causes chronic respiratory diseases and premature mortality and imposes greater health spending to mitigate the impacts (Narayan & Narayan 2007). Hence, a lack of environmental conservation will impose greater health spending on neighbouring districts.

3.3 Environmental conservation and fiscal transfers in Indonesia

Indonesia is a country rich in natural wealth, where 45 per cent of natural wealth is subsoil assets while crop land accounts for 36 per cent of natural wealth. Based on World Bank estimation, natural capital constitutes a share of 25 per cent of total national wealth, the highest among East Asia and Pacific countries. However, this figure does not include fishery wealth (World Bank 2009). With almost 52 per cent of land having forest cover, forests not only provide an important source of living for local communities, but are home to many crucial important sectors. The natural resource abundance has made agricultural land resources an important source for development.

Due to their high value endowment, both under and on the soil, forests in Indonesia are suffering from deforestation and land degradation. This brings consequences, i.e. environmental impacts resulting from forest exploitation. Forest loss is the main environmental issue in Indonesia because of the high deforestation rate over decades and its complex and far-reaching effects. However, the impact of forest loss is more than just tremendous biodiversity loss; the impact of haze pollution from forest fires has sparked both economic and health concerns.

Environmentally destructive activity includes land use and land use change in forestry and the agricultural sector, including deforestation. Indonesian forests are threatened by logging and agricultural clearance that results in deforestation. In addition, forest fires, illegal logging, illegal mining, and land clearing for plantations have posed further pressure on forest resources. Land degradation has not only caused more frequent floods due to soil erosion, but also adds to significant adverse effects on climate change. In addition, air pollution from both energy use and transportation has become a major environmental problem in Indonesia.

ADB (2009) estimates that by the end of this century, the annual economic cost for Indonesia could reach 2.5 per cent of GDP if only market impacts are considered; 6.0 per cent of GDP if non-market impacts are included; and 7.0 per cent of GDP when catastrophic risks are taken into account. The high concentration of people living in coastal areas, a high dependence on agriculture and natural resources, a relatively low adaptive capacity, and a tropical climate are some factors contributing toward climate vulnerability in Indonesia.

The environmental degradation not only impacts the economic dimension, but also the health dimension of affected people. With regard to human excreta management and hygiene, a recent World Bank report has estimated that major health, water, tourism and other welfare costs associated with poor sanitation had economic impact amounting to about $7.6 billion in 2007, or almost 2 per cent of GDP the same year (World Bank 2007a). The summarized environmental degradation cost is displayed in Table 3-1.

Table 3-1 **Summary of economic costs from environmental degradation**

SOURCE OF DEGRADATION	ECONOMIC COST ($ billion 2007)	ANNUAL GDP LOSS** (%)
Climate change	N/A*	2.5–7.0 (by 2100)
Water, sanitation and hygiene	7.7	2+
Outdoor air pollution	3.9	1.2
Indoor air pollution	1.6	0.4
Forest degradation	N/A	N/A
Soil degradation	$562 million (Java, 1985)	0.13
Coastal and marine environment	N/A	N/A

Source: World Bank (2009, p. 13)

*The economic cost of climate change is increasing over time. It represents estimated total cost incurred due to environmental degradation. The negative effects of climate change include reduced crop production, sea-level rise, greater risks of flooding, coral reef bleaching, and further spread of vector-borne diseases. The economic cost of these impacts is projected to reach 2.5–7.0 per cent of GDP by 2100. Using current GDP 2007, it is estimated the economic cost reached $102 billion.

** Annual GDP loss represents the economic cost to Indonesia's economy annually.

Table 3-1 also shows that environmental degradation due to climate change contributes greater economic impact than other sources. For Indonesia, the increased levels of

atmospheric carbon dioxide are mostly produced by land use and land use change (LULUC). A recent study from Margono et al. (2014) reports a spatially and temporally explicit quantification of Indonesian primary forest loss totalling over 6.02 Mha from 2000 to 2012 and increasing on average by 47,600 ha per year. By 2012, annual primary forest loss in Indonesia was estimated to be higher than in Brazil (0.84 Mha and 0.46 Mha, respectively).

3.3.1 The decentralization of environmental management

The fiscal decentralization introduced in 2001 brought greater involvement of local governments in environmental management in Indonesia. Local environmental agencies have received a comprehensive mandate to upgrade the scope and quality of their services and performance. Through Law number 38 year 2007, the central government stipulated policy on the delegation of authority to both provincial and regency/municipality governments for the purpose of environmental development implementation. Further, law number 41 year 2007 sets out basic principles for establishing environmental institutions, and describes the function of environmental officers between tiers of governments.

Based on law number 32 year 2004 about local government administration, the administrative functions which fall under central government authority are foreign policies, defence, security, judicial, national fiscal and monetary, and religion. The areas under the authority of local governments include planning and control of development; planning, utilization, and oversight of land use/ zoning; the conduct of public order and security; provision of public facilities and infrastructure; public health; education; social problems; services in the labour sector; the development of cooperatives and small- and medium-scale enterprises; environmental management; agrarian services; population and civil registry services; general government administrative services; investment

administration services; and other basic services. Considering the externality impact, accountability and efficiency factor, thirty one public service areas are split and jointly coordinated between tiers of local governments, including environment, forestry, sea and marine, energy and natural resources.

Among the area under the authority of local governments, it is expected that environmental and forest decentralization will bring benefits to better forest conservation as local governments can closely monitor forestry issues in their region. The role of local government in forest conservation is carried out through many aspects, including infrastructure for forest conservation and the enforcement of rule of law. In addition, the management of forest fire problems. The literature suggests that decentralization in forest management will result in more cost effective forest conservation.

Through intergovernmental fiscal transfer mechanisms, central government provides financing support to local governments to comply with national environmental policies. One of them is the environmental special allocation fund for certain districts aiming to boost participation of local governments in environmental conservation efforts. Specifically, this special allocation aims to address one of the biggest issues, that is, that district governments have few incentives for sustainable environmental management, and inadequate financing to achieve environmental objectives at the local level (World Bank 2007, p. 27).

Based on Internal Minister Decree no 16 year 2006, local government public spending is classified into eleven functions, including local government spending for environmental functions. This spending covers various programs, including waste management, programs addressed to control pollution and environmental degradation, natural resource conservation, protection, restoration and rehabilitation (forest, coral

reef), forest fire control programs, and marine ecosystem rehabilitation. Other environment-related spending is forestry which is classified as an economic function. The forestry spending aims to address the rehabilitation of forests and land, programs aimed at forest resource conservation, and forest production management.

Although it can be difficult to calculate the sufficiency of environmental spending to cover environmental degradation, previous studies show huge environmental costs as a result of current environmental policy and practice. The lowlands of Sumatera and Kalimantan were the site of more than 70% of total forest clearing; over 40% of the lowland forests of these island groups were cleared from 1990 to 2005 (Hansen et al. 2009). Subsequently, Henstridge et al. (2013) estimate Indonesia may have lost around US$160 billion, or around 5% of GDP per year, between 1990 and 2005 from deforestation.

Not only at sub-national level, the World Bank (2009, p.30) has raised concern over the relatively low spending for environmental purposes for most of the decade at national level. Two reasons account for this trend. First, traditionally the government prioritizes other sectors under its national development plans. Secondly, the low level of environmental expenditure points to inadequate environmental revenue collection, and the under-pricing of environmental resources.

Public spending for environmental functions at sub-national level is very low compared to other spending functions. Table 3-2 displays the percentage of local governments' selected spending in Sumatera and Kalimantan as a function over total spending. On average, education ranks top of local government spending composition, followed by general administration and infrastructure spending. However, the portion of environmental spending is very low compared to other types of spending, averaging only two per cent of total expenditure. In addition, unlike education spending with its

upward trend, environmental expenditure shows a constant stable trend during the period of observation. Moreover, infrastructure spending also shows an upward trend compared to other types of spending. The allocation of environmental spending at district level is not much different from average provincial and central government levels.

Table 3-2 **The percentage of expenditure by function over total expenditure**

	District			Province			Central		
Expenditure function	2010	2011	2012	2010	2011	2012	2010	2011	2012
Education	25	26	30	21	21	22	13	11	10
Environment	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Health	7	7	9	1	2	2	3	2	2
Infrastructure	14	13	16	22	20	20	12	13	14

Source: Own calculation based on MoF published annual budget note and World Bank-Indodapoer.
Note: Figures are rounded. Central government total expenditure excludes intergovernmental fiscal transfer. Environmental spending includes forestry spending.

Central government supports local governments' spending for specific and prioritized sectors through the provision of earmarked transfers aiming to help to finance activities under local governments' authority which align with national priorities. The size of special allocation grants is complicated and based on certain formula leading to limited eligibility for conditional grant allocation.

Since 2006, the central government has provided special allocation grants for the environment, including for environment DAK, aimed to improve the environmental quality of air, water and land through promoting a higher role of local governments[15].

[15] There were 19 sectors (22 subsectors) prioritized for DAK allocation in 2012. DAK calculation uses a top-down approach where central government allocates the funding and assigned local governments provide the plans. The eligibility criteria for DAK allocation is based on three criteria. The first criterion is a general criterion, this is related to local fiscal capacity. Every year the MoF issues Net Fiscal index which is obtained from local fiscal capacity over average national fiscal capacity of local governments. The second criterion is special criterion which places local characteristics, such as disadvantageous districts and sea side districts. Based on the relevant regulations and local characteristics, the MoF issues what is called regional index. The third one is technical criterion which is determined by relevant technical departments. Local governments must submit DAK is transferred in three tranches: the first is allocated after the budget is submitted to the central government; the next two tranches depend on the depletion of the previous tranche. Based on law number 33 year 2004 that local governments need to allocate matching fund (*dana pendamping*) at least 10% of allocated DAK for each sector.

Table 3-3 shows the composition of the special allocation fund (DAK) where DAK for education reaches almost half of total DAK. This reflects the commitment of central government to support local governments to reach at least 20% of budgets allocated for education. The declining trend of road DAK results from additional infrastructure sectors, such as irrigation and drinking water. However, DAK for environment is still low, only 2% on average of total DAK. This figure was persistently stable over the period of study. Another environment-related special grant is the forestry special grant which was introduced in 2008. This transfer aims to particularly support reforestation programs in assigned districts. The Ministry of Forestry issues technical guidance for the fund usage every year, with most funds directed to programs to prevent further forest damage. Despite its importance, the portion is very low, despite an upward trend.[16]

Table 3-3 **DAK composition for selected sector (in percentage of total DAK allocation)**

Year	Environment	Forestry	Education	Road
2006	1.0	0	25.3	33.0
2007	2.1	0	30.4	18.2
2008	1.7	0.5	33.1	19.1
2009	1.5	0.5	39.8	16.2
2010	1.7	1.2	46.0	11.8
2011	1.7	1.6	42.0	13.9
2012	1.9	1.9	40.5	13.8

Source: Ministry of Finance. Figures are rounded.
Note: Forestry DAK started in 2008.

Although the provision of environmental DAK shows the central government's commitment toward environmental conservation, the persistent low fraction of environmental DAK compared to other sectoral conditional grants suggests education

[16] Local governments' expenditures for forest preservation are recorded at economy expenditure function.

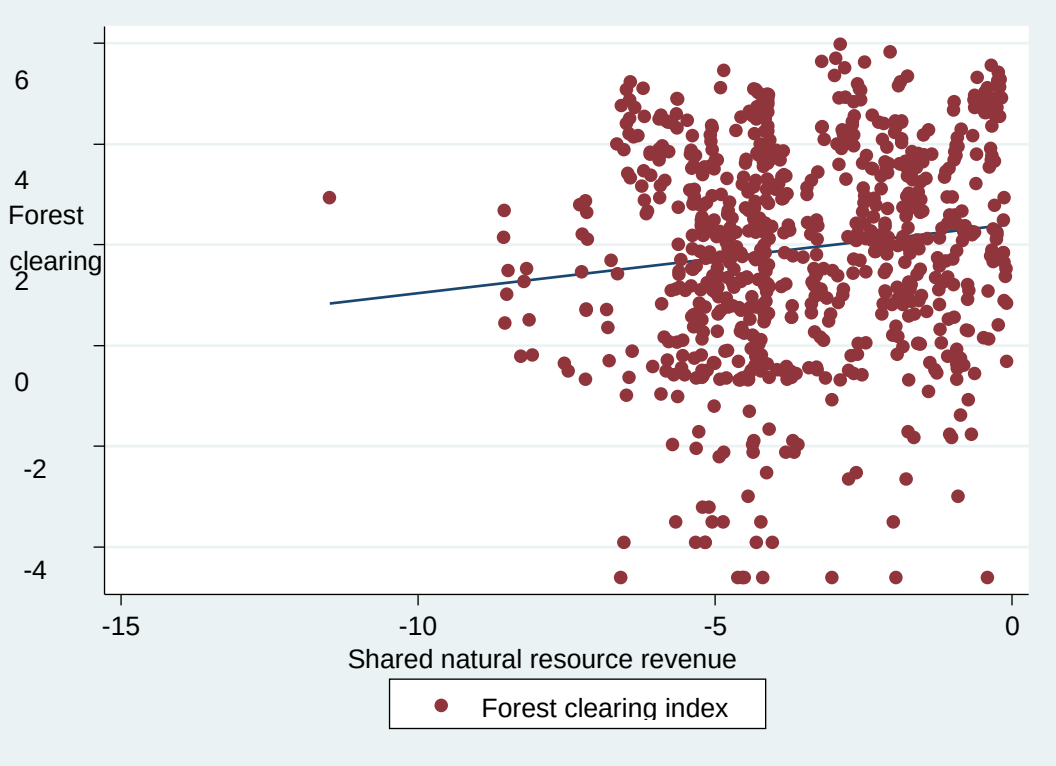
and infrastructure ranks top among central government priorities. Given the significant economic loss due to environmental degradation, larger environmental special grants will be required.

3.3.2 Environmental quality and extractive industries

Mining sites in the forestry area reach more than 15 million hectares or around 15% of total forest size (FWI 2010). Although mining contributes an important portion of national revenue, it unfortunately contributes toward environmental devastation. Abood et al. (2014) find oil palm plantation, logging, fibre plantation (pulp and paper), and coal mining concessions accounted for 44.7% (6.6 Mha) of forest loss in Kalimantan, Sumatera, Papua, Sulawesi, and Moluccas between 2000 and 2010. Illegal mining and illegal logging have plagued this sector and lead to massive devastation.

Previous studies have found that regions which are dependent upon the mining sector and rich in the forest sector have imposed significant environmental destruction (see Resosudarmo et al. 2009). The extent of the role of natural resource extraction in environmental degradation, proxied by deforestation, can be seen in Figure 3-1. Using the forest clearing index from Wheeler et al. (2012), the positive trend between shared natural resource revenue and deforestation rate is shown. The positive fitted line shows that larger shared natural resource revenue leads to a bigger deforestation rate.

Figure 3-1 **Two way graph forest clearing and shared natural resource revenue**



Source: Stata estimation based on data from Wheeler et al. (2013).
Note: Forest clearing data covers the year of 2006–2010 for 193 districts in Indonesia. Data is in log form.

3.4 Data and empirical specification

3.4.1 Data

This study uses data from regencies and municipalities in Sumatera and Kalimantan Island for the period of 2009–2012. For the whole paper, district implies regency or municipality. District level is the third layer of government after national and provincial levels. District is classified into two groups, *kabupaten* (regency) and *kota* (municipality). This classification is based on the demography, land area and income source. A regency has a wider area but lower population density and is more dominated by the agricultural sector. A municipality has a smaller area and generally is the capital of a province.

The analysis draws mainly on three sources of data. At the core is panel data on Indonesian local governments' public finances, which is obtained from the Directorate

General of Finance Balance at Ministry of Finance. This study also benefits from the World Bank's INDODAPOER database. The other financial data sources are mainly obtained from the Ministry of Finance, Ministry of Internal Affairs, publications by the statistics office and the Ministry of Forestry and Environment. The non-economic and fiscal data, including regional gross domestic product and population characteristics, are obtained from the INDODAPOER database. Data on district borders and neighbouring districts are obtained from the Ministry of Internal Affairs.

All economic and fiscal data are real term data, where nominal data are deflated by each district's RGDP deflator. This aims to minimize data distortion due to price movements. Table 3-4 displays the descriptive statistics of data used in this study for all districts.

Table 3-4 **Descriptive statistics**

Variable	Observations	Mean	Std. Dev	Min	Max
Environmental expenditure	796	0.034	0.040	7.45e-10	0.487
Other transfer	796	1.22	1.94	0.03	28.23
Conditional grant (environment and forestry)	796	0.003	0.003	2.09e-10	0.02
Own revenue	796	0.081	0.132	0.003	2.67
GRDP/capita	796	10.18	12.87	1.07	173.10
Poverty rate (%)	796	11.69	5.86	2.17	30.75
Population density (per km^2)	796	488	1,210	1	8992
Literacy rate	796	95.674	3.617	67.79	100
The share of extraction sector/GRDP	796	0.422	0.221	0.003	0.920
Province environmental spending	796	0.006	0.007	0.0003	0.025

Note: All fiscal and economic variables are measured in million rupiah in constant 2000 term and in per capita term. For districts with missing data due to no transfer or zero data, I impute the data by dividing the smallest observed value.

4.2. Estimation model

In spatial econometrics, the two main data generating processes that incorporate spatial dependence into a regression specification are spatial lag and spatial error models (Anselin 1988).The spatial dependence reflects a situation where values observed at one location or region, say observation *i*, depends on the values of neighbouring observations at nearby locations, say *j* (LeSage & Page 2009). Hence, an econometric estimation with the value of a dependent variable *y* in region *i* or y_i, does not depend

only on the explanatory variables (vector Xs), but also depends on the *y* value of its neighbours ($y_{j...}$). This model is called the spatial autoregressive model or spatial lag model. Formally, spatial dependence exists when $Corr(y_{i,} y_j)=E(y_{i,} y_j) – E(y_{i)} E(y_j) \neq 0$.

The standard panel model takes the form:

$$y_{it} = \rho \mathbf{W}_{ij}\mathbf{y}_{jt} + \boldsymbol{X}_{it}\beta + \epsilon_{it}, \quad (1)$$

$\boldsymbol{y}_{it}$ and $\mathbf{X}_{it}$ are dependent and explanatory variables respectively, ρ is the scalar parameter obtained from the multiplication of weighting matrix W and y_{ij} and is called the spatial autoregressive coefficient. ρ describes the strength of spatial dependence of the data. $\mathbf{W}_{ij}\mathbf{y}_{jt}$ is a weighted average of neighbouring districts' real per capita environmental expenditures (W is a geographical weighted matrix). $\boldsymbol{X}_{it}$ represents the vector of controlling variables, while μ_i denotes a unit specific effect and t_t denotes time dynamic effect. The error term ϵ_{it} satisfies the classical assumptions of independent identical distribution (i.i.d) with constant variance σ^2.

As LeSage and Page (2009) explain, the additional term $\mathbf{W}_{ij}\mathbf{y}_{jt}$ is called a *spatial lag*, since it represents a linear combination of values of the variable *y* constructed from observations/regions that neighbour observation *i*. It should be noted that the term lag in this case is lag between spatial units, not in terms of time dimension. This is accomplished by placing elements W_{ij} in the *n×n spatial weight matrix W*, such that $\mathbf{W}_{ij}\mathbf{y}_{it}$ results in a scalar that represents a linear combination of values taken by neighbouring observations.

On the other hand, spatial effect or spatial heterogeneity is incorporated in the error structure, called a spatial error model. This model posits that the dependent variable depends on a set of observed local characteristics and that the error terms are correlated across space. In the empirical literature, the spatial error model is consistent when

dealing with a situation where expenditure determinants on specific public goods are omitted from the model and are spatially auto-correlated (Elhorst 2010). One example has been elaborated in the theoretical consideration section. Instead of finding the spatial correlation through the dependent variable or from the error term, the spatial interaction with independent variables is of interest in some studies. For example, the level of environmental spending in district j depends on the poverty rate in district j as well as on the poverty rate in neighbouring districts. This model can be combined with the spatial autoregressive of the explanatory variables, as well as spatially dependent disturbances.[17]

This study uses explanatory variables which have been used by previous studies to explain the environmental spending equation. Previous studies examining the determinants of environmental spending use advanced economies as their research samples (Newmark & Witko 2007; Bacot & Dawes 1996) emphasizing the role of political pressure over state environmental policies. In addition to political pressure, Newmark and Witko (2007) employ population and fiscal health of sub-national governments as explanatory variables in their econometric estimation. Wang and Di (2002) use income per capita and industrial employment levels among other explanatory variables which influence the environmental performance of city government in China. Boyce (1994) argues that inequality in power and wealth leads to more environmental degradation. This study also employs the poverty rate as an independent variable to capture the imbalance of wealth in a community, which leads to higher levels of environmental degradation. Hence, the poverty rate will be associated with lower environmental spending.

[17] The spatial error model is as follows: $yit = Xit\,\beta + \mu i + tt + \varphi it$, where $\varphi it = \delta Wij\ \varphi it + \epsilon it$.
This model suggests spatial dependence between omitted variables and dependent variables, where the error term has two components, $Wij\ \varphi it$ and ϵit. The spatial Durbin with following model is as follows: $yit = \delta WijXit + Xit\,\beta + \mu i + tt + \epsilon it$. The spatial Durbin model can contain both a spatially autoregressive dependent variable and spatially autoregressive independent variable.

Population density plays an important role in affecting environmental quality. Greater population density leads to an increased need and competition for resources, including environmental resources, which in turn, leads to detrimental impacts when this problem is not well managed. Greater own-source revenue at district level indicates greater fiscal capacity. With regard to special grants for the environment (DAK), local governments need to provide matching funds for environmental DAK. For this purpose, it is reasonable to expect a positive association between own-source revenue and environmental spending because greater environmental spending encourages greater own-source revenue to provide the required matching funds. Theoretically, the substitution effect from conditional grants reduces the price of subsidized public services, hence it stimulates higher spending. Conversely, the effects of other types of fiscal transfers are inconclusive as theory suggests.

In his study, Revelli (2003) finds that when vertical expenditure externalities among upper- and lower-tier authorities are explicitly taken into account (because of complementarity/substitutability between public expenditures at the two levels of government), the estimated magnitude of between-districts interaction is substantially reduced. He concludes that the observed positive spatial autocorrelation among district expenditures can be attributed to a large extent to common reaction to county expenditures, rather than to actual strategic interaction. Hence, the exclusion of provincial level spending leads to omitted variables in the econometric equation.

Although the interaction channel can occur through covariates in error variables as in the spatial error model, as the main purpose of this study is to examine the presence of spatial interaction among local governments in decision making for environmental spending, this study uses a spatial autoregressive model to estimate spatial interaction. The basic estimating model with spatial effects can be written as follows:

$$y_{it} = \rho \mathbf{W}_{ij}\mathbf{y}_{it} + \beta_0 + \beta_2 \boldsymbol{X}_{it} + \epsilon_{it}, \qquad (2)$$

y_{it} represents a district's environmental spending,[18] ρ represents the spatial autoregressive coefficient of environmental spending per capita, and **W** represents a spatial contiguity weight matrix. **X** is a vector of control variables, comprising fiscal transfers, covering the general purpose transfer (DAU) and shared revenues (tax and natural resource-revenue sharing) and conditional environmental transfer, real per capita gross regional domestic product (GRDP), population density per kilometre^2, poverty rate, and own-source revenue in per capita terms, and literacy rate and provincial environmental spending per capita. ε_{it} is an error term capturing all other omitted factors, with $\mathbf{E}(\varepsilon_{it}) = 0$ for all i.

3.4.2 Econometrics result discussion

The first step in assessing the spatial correlation is to develop a weight matrix, defining the neighbourliness of spatial units. The weight matrix is based on the number of spatial units and a symmetry matrix. The weight matrix can be constructed in a large number of ways, for example based on classification or group, distance, or contiguity. With contiguity, the underlying structure of neighbourliness is 0–1 values. If two spatial units have a common border of non-zero length, they are considered contiguous and assigned value 1, or otherwise zero. Under distance structure, matrix weight is based on distance between units, which can use longitude and latitude (see Getis & Aldstadt 2004) for a detailed discussion).

This study employs two approaches to determining the extent to which two districts are neighbours, the geographical proximity criteria and natural resource revenue endowment group. With geographical criteria, districts which share a physical border

[18] Based on accounting principles, the disbursement of a conditional grant is recorded under related expenditure account. For estimation purposes, environmental spending is net spending after subtracting environmental and forest special allocation grants.

are treated as neighbours. In this case, the neighbouring districts will share the adverse impact of environmental degradation resulting from a lack of environmental policies. Hence, isolated districts or non-physical shared border districts are excluded.[19] The second approach is to split the districts based on natural resource endowment, into non-mineral-producing and mineral-producing districts. This assumes that the districts falling into the mineral producer group will have similar environmental challenges, and they may imitate the neighbours' fiscal policy, environmental spending in this case. Hence, a local government will refer to its neighbours' environmental spending as argued in the correlated effect hypothesis. This study uses a contiguity basis where neighbouring districts which share a common border or fall under the same natural resource endowment group are assigned 1, then $w_{ij} = 1$ or otherwise zero.

The first step of analysis is to run Moran's *I* and Geary's C test to formally investigate the spatial autocorrelation among districts with the null hypothesis that there are no spatial effects. Both of these tests produce an index used to detect the pattern of observed variables, whether they disperse, converge or cluster, or are random. The Moran's *I* statistic provides an indication of the degree of linear association between the observed variable and a vector of spatially weighted averages of neighbouring values (**Wx**). The Moran's I index values range from −1 to +1. The negative value of Moran's I index indicates the tendency of the observed variable toward dispersion, suggesting an inverse association of environmental spending among units or districts. A positive value of Moran's I suggests a tendency in the data toward clustering, or that a district's environmental spending is positively associated with its neighbours' environmental spending. The Moran's I index can be calculated from the following formula: (n/S_0) $(\sum_i \sum_j w_{ij} z_i z_j / z_i^2)$, where n is number of observations, S_0 is an aggregate of all the spatial

[19] The excluded districts are Simeulue, Mentawai, Karimun, Batam, Lingga, Anambas and Natuna.

weight or $\sum_i \sum_j w_{ij}$, and z_i, z_j are deviations of the variable of interest from the mean (Anselin 1995).

On the other hand, Geary's C test is inversely related to Moran's I. The value of Geary-*C* lies between 0 and 2. A value of 1 means no spatial autocorrelation. Values lower than 1 demonstrate increasing positive spatial autocorrelation, whilst values higher than 1 indicate increasing negative spatial autocorrelation. The formula for the Geary's C test is as follows: $(N-1)\sum_i \sum_j w_{ij}(X_i-X_j)^2 / 2W\sum_I (X_i-\bar{X}_j)$, where N is the number of spatial units indexed by i and j, X is the variable of interest; bar X is the mean of X; w_{ij} is a matrix of spatial weights; and W is the sum of all w_{ij} (Jeffers 1973). The inference of Moran's I and Geary's C are based on a z-value of C-1/sd(C) for Geary-C, where C represents observed Geary value and sd is the standard deviation. The z-value for Moran-I is obtained by (*I*-E (*I*)/sd(*I*)), where I represents observed Moran-I value, E (*I*) denotes expected I value and sd (I) denotes the standard deviation of observed I value.

Detecting the spatial correlation of environmental spending data among districts, I employ both Moran-I and Geary-C tests for comparing the results. Because Moran-I and Geary-C test spatial autocorrelation for cross section data, I undertake the test for each year of observation. Table 3-5 shows the results. Both Moran-I and Geary-C confirm the presence of spatial correlation of environmental spending among districts in Sumatera and Kalimantan with border share matrix, although the Geary test does not confirm the year 2010[20]. The statistically significant spatial autocorrelation tests provide evidence about the clustering pattern in environmental spending at local governments in Sumatera and Kalimantan. It should be noted that the results of the Moran-I and Geary-C tests only inform about data spatial patterns, but cannot say what is driving the spatial pattern. The econometric regression will explain this spatial pattern and provide

[20] Cliff and Ord (1981) have shown that Moran's I is consistently more powerful than Geary's C.

evidence about whether there is environmental spending interdependence through spatial lag, as argued in this paper.

Table 3-5 **Spatial autocorrelation test: Environmental spending per capita**

	W=border share				W= Natural resource producing group			
Year	Moran-I value	z-score	Geary -C value	z-score	Moran-I value	z-score	Geary-C value	z-score
2009	0.158	3.15***	0.865	-1.42*	-0.009	-0.564	1.004	0.564
2010	0.224	4.51***	0.888	-1.02	-0.009	0.531	1.004	-0.531
2011	0.245	5.52***	0.790	-1.28*	-0.007	-0.394	1.002	0.394
2012	0.424	8.50***	0.640	-3.17***	-0.005	-0.037	1.000	-0.037

The natural resource endowment weight matrix does not suggest the presence of spatial interaction of environmental spending data. In other words, a natural resource producing district in Sumatera will not consider environmental spending of districts in Kalimantan, although they are classified in the same group. This seems to be in line with Brueckner (2003) who found that close-by jurisdictions are more likely to affect each other than far away ones.

3.4.3 Econometric estimation result discussion

The formal spatial correlation tests in the previous section find evidence of interdependence among local governments in environmental spending policies. Two main approaches have been suggested in the literature to estimate models that include spatial interaction effects. One is based on the maximum likelihood (ML) principle and the other on instrumental variables or generalized method of moments (IV/GMM) techniques (Elhorst 2003). Based on the spatial correlation test above, the econometric estimation will use only the border share weight matrix. Table 3-6 displays the estimation results.[21]

[21] LeSage and Pace (2009) demonstrate that the effects of individual variables in a model are comprised of a partial derivative of a combination of all model coefficients. The *spregdpd* command does not provide direct, indirect and total effect, but only partial derivative effects for explanatory variable spillover.

Table 3-6 **Econometric estimation results: Dependent variable = Environmental spending per capita**

Independent variables	Generalized spatial two-stage least squares (GS2SLS)	Spatial IV/GMM (Spatial autoregressive)	Mineral and timber producing districts only (Generalized spatial two-stage least squares)	Mineral and timber producing districts only Spatial IV/GMM (Spatial autoregressive)
	1	2	3	4
Temporal Lag-Environment spending	N/A	0.100*** (0.010)	N/A	0.042*** (0.012)
W*Environment spending	0.271*** (0.068)	0.298*** (0.062)	0.339*** (0.079)	0.334*** (0.091)
Other fiscal transfer	0.011*** (0.0008)	0.006*** (0.0005)	0.010*** (0.0008)	0.007*** (0.0008
Special grant for environment and forestry	1.145 ** (0.397)	0.275 (0.593)	0.715* (0.370)	1.222* (0.692)
Own revenue	0.059* (0.031)	0.332*** (0.074)	0.050 (0.034)	0.417*** (0.089)
RGDP growth	0.0002 (0.0001)	-0.0004 (0.0003)	0.0002* (0.0001)	0.0001 (0.0005)
Poverty rate	-0.0002 (0.0002)	-0.0006 (0.0007)	-0.0002 (0.0003)	-0.0005 (0.001)
Population density	3.21e-06 ** (1.30e-06)	1.66e-06 (7.13e-06)	7.47e-06 * (3.92e-06)	0.00003 (0.00004)
Literacy rate	0.0001 (0.0001)	0.0002 (0.0002)	0.0001 (0.0002)	0.00068 (0.0007)
Provincial environmental spending	1.82e-07 (2.19e-07)	2.75e-07 (2.31e-07)	5.84e-08 (2.66e-07)	1.28e-07 (2.54e-07
No. observation	796	597	596	447
No. group	199	199	149	149
R^2 (Raw Moments)	0.78	0.82	0.77	0.79
F-test	42***	133***	34.2***	54***
Log likelihood	1897	1420	1353	1017
Sargan over-identification test(*p-value*)	N/A	24.1(0.51)	N/A	20(0.74)

Note: All fiscal variables are measured in real per capita terms. The figure in brackets is standard error. The signs ***, **, and * indicate significance at 1, 5, 10 per cent respectively.

Because the *y* variable appears in the right and left sides of the equation, the spatially lagged variable (W*y*) on right hand side is treated as endogenous. Besides, the potential simultaneity can result from a special transfer allocation (DAK). The disbursement of this fund is allocated into three tranches which depend on the extent of the use of the fund. As such, total DAK allocations in one fiscal year are a function of local

government environmental spending during the related year. Hence, the DAK must also be considered as endogenous (see Lewis 2013).[22]

The obvious question in the previous analysis is that of endogeneity of the explanatory variables owing to Wy (the spatially lagged dependent variable). To overcome the possible endogeneity bias, Kelejian and Prucha (1998) suggest an instrumental variable method obtained from internal variables, known as the generalized spatial two-stage least squares (GS2SLS) procedure.[23] The GS2SLS estimation confirms the presence of spatial interaction in environmental spending in these districts. The coefficient of the spatially autoregressive dependent variable is interpreted as the degree of interaction among jurisdictions (Elhorst & Freret 2007). The GS2SLS estimation shows an interaction coefficient of 0.271, suggesting that a district will increase its own environmental spending by 0.271 million IDR (or 271.000 IDR) in response to a one million rupiah increase in its neighbours' environmental spending in per capita terms, ceteris paribus. The positive and significant spatial correlation provides evidence that environmental spending becomes complementary to a district's own environmental spending over its neighbours.

Own-source revenue and fiscal transfers, covering shared revenue and general purpose grants (in per capita terms), are important sources of environmental spending as expected. Nevertheless, the positive and greater effect of own-source revenue than intergovernmental fiscal transfers for environmental spending suggests the absence of the flypaper effect in environmental spending in these districts.

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[22] In addition, one of the components in other transfer revenue, unconditional grant (DAU) can be simultaneous. The DAU formula allocation is based on past actual local expenditures (including environmental expenditures). Therefore, local governments' environmental spending in one period affect DAU allocation in a subsequent period. Thus, the DAU is treated as predetermined or weakly exogenous according to the definitions employed in the GMM regression analysis.

[23] The GS2SLS procedure proceeds as follows. In the first step, the regression model in Equation (4) is estimated by two-stage least squares using a set of instrument variables, H (X, WX, W^2X). That is, we regress Wy on X, WX, W^2X and use the fitted values of Wy as instruments for Wy. In the second step, we estimate the autoregressive parameter ρ by generalized method of moments using the residuals obtained in the first step. In the final step, we use the estimates of ρ to perform a spatial Cochrane–Orcutt transformation of the data and obtain efficient estimates of β and λ. However, some potential instrumental variables for conditional grant are not valid. Hence, the internal instruments will be employed as GMM approach suggests.

Interestingly, the conditional grant for environment and forestry does not have a stimulative effect on environmental spending. One potential explanation is due to the fungibility of conditional grants (Shah 2007), meaning spending in the specified area increases by less than the amount of the grant. All of the grant funds are expended on environmental spending, but some own-source revenues are diverted into other uses. The fungibility of conditional grants depends on both the level of spending on assisted public services and the relative priority of such spending. If the recipient's own-financed expenditure in the assisted category exceeds the amount of the conditional grant, the conditionality of the grant may not have any impact on the recipient's spending behaviour, which is the case for districts where own environmental spending is greater than conditional grants for the environment. Among non-fiscal variables, only poverty has a significant positive effect on environmental spending. Although the coefficient sign is negative as expected, the poverty rate is not significantly associated with environmental spending.

To take into account the potential endogeneity of conditional grants for environment and forestry, the dynamic panel data (DPD) model with systems generalized method of moments (GMM) estimation procedures is employed.[24] Column 2 in Table 3-6 shows the estimation results. After taking care for the endogeneity issue, the spatial coefficient sign (rho) rises to 0.30 from 0.27, suggesting a greater spillover impact from neighbours' environmental spending decisions. The Sargan test for testing the validity of the over-identification restriction indicates that the employed instruments are valid.

[24] The GMM procedure is preferred approach because it can deal with endogeneity and small T and large N. The GMM takes differenced approach to eliminate the time invariant unobserved heterogeneity. For the instrument variables, the differenced equation uses lagged levels of the endogenous and predetermined variables and differences of the exogenous variables. Instruments for the level equation can also be employed and these comprise lag differences of endogenous and predetermined variables, as well as all exogenous variables. Two-step estimation is employed.

The magnitude of the stimulative effect of own-source revenue is consistently greater than fiscal transfers in promoting environmental spending. It is interesting to note that despite the limited revenue base, own-source revenue has a significant positive effect on environmental spending in both estimation approaches. One potential explanation for significant positive effects of own-source revenue over environmental spending is that local government revenue bases are characterized by the consumption of goods and services. Local governments have power to tax restaurants, hotels, entertainment, advertising, street lightning, certain minerals, parking, ground water, swallow birds' nests. Local governments also have power to collect charges or retribution from government-provided services. Hence, the bigger consumption from economic activity, the bigger potential own-source revenue, and consequently, the greater waste produced and the greater environmental spending needed.

Following Revelli's (2003) finding, the inclusion of provincial spending in all models shows a persistent positive spatial coefficient; reflecting that strategic interactions among local governments determine their environmental spending, rather than reactions toward environmental spending from the provincial level. Moreover, all models do not provide evidence of the role of the provincial level's environmental spending toward districts' environmental spending.

Because polluting sectors contribute toward greater pollution in hosting districts, it is obvious that the interaction magnitude will be greater. I estimate the district sample for mineral and timber producing districts only. The estimation result in columns 3 and 4 of Table 3-6 show that the spatial coefficient in mineral and timber producing districts remains significantly positive with a magnitude of 0.33. This greater coefficient size results suggests the dominant role of this group of districts in the presence of spatial interaction.

3.4.4 Does pollution serve as the source of spatial interactions?

The lack of environmental spending makes the mineral and timber producing districts unable to mitigate the environmental consequences associated with activities in polluting sectors. The negative effects of uncontrolled pollution spread across boundaries, affecting the welfare of residents in neighbouring jurisdictions (Case et al. 1993; Revelli 2006). This situation undermines the environmental condition and forces the affected neighbouring districts to expend greater environmental spending to mitigate the impacts, leading to positive interaction. Following the argument developed in the previous section, the uncontrolled polluting becomes the channel of this spatial interaction.

There is a vast literature highlighting the potential for extractive industries, such as mining, to pollute the environment. Rau et al. (2013) find that children living in proximity of mineral wastes had higher concentrations of lead in their blood, and worse academic performance. Aragón and Rud (2015) study the effect of pollution from gold production on agriculture in Ghana. They find evidence that cumulative gold production (a measure of the stock of pollution) is associated with a significant reduction in agricultural productivity. Previous studies have found a negative impact of the mining sector on the environment in Indonesia. Fatah (2007) finds the detrimental impact of the Indonesian coal sector in South Kalimantan. Carlson et al. (2013) estimate the plantation expansion in Kalimantan alone is projected to contribute 18–22% (0.12–0.15 GtC yr^{-1}) of Indonesia's 2020 CO_2-equivalent emissions.

Extractive and agricultural industries, such as mining, oil extraction and forest logging, have potential to pollute the environment. Mining industries can generate significant amounts of air pollutants such as nitrogen oxides (NOx) and sulphur dioxide (SO_2). Agricultural expansion, accompanied by forest clearing, can damage forests and release

emissions and particulate matter, impacting the quality of air, water and soil. I investigate whether neighbours' pollution levels affect a district's environmental spending. However, district level data of pollution are not available. Some previous studies (see Aragón & Rud 2013) proxy the pollution level in the gold mining sector with cumulative gold production. On the other hand, van der Goltz and Barnwal (2014), and Rau et al. (2013) use the distances from affected communities to the mine sites or pollution sources.

This study uses shared natural resource revenue as a proxy for pollutant stock. Greater shared natural resource revenue requires greater natural resource exploitation, leading to greater consequences to the environment (see Abood et al. 2012). Following Resosudarmo et al. (2009), the extractive sector has significantly contributed toward environmental degradation in Indonesia. In addition to the extractive sector, deforestation in the forestry sector is also considered as pollution. The bigger the size of the natural resource extraction sector, the greater environmental consequences which require greater environmental spending. Besides, the use of shared natural resource revenue can cover all potential sources of pollution.

To investigate the presence of pollution spillover, proxied by shared natural resource revenue, the econometric estimation will be undertaken with the following model:

$$y_{it} = \beta_1 \mathbf{W}ij*\text{Shared natural resource revenue}_{it} + \beta_2 \boldsymbol{X}_{it} + \rho_t + \boldsymbol{\alpha_i} + \epsilon_{it}, \qquad (3)$$

With similar explanatory variables to model (2), I use a fixed effect approach to estimate the effect of neighbours' shared natural resource-revenue sharing over a district's environmental spending. Column 1 in Table 3-7 shows the significant and positive impact of neighbours' shared natural resource revenue over a district's own environmental spending. This result suggests that a district increases its environmental

spending by 10.000 IDR per capita for every one million IDR increase in natural resource-revenue sharing in neighbouring districts. This explains the arguments developed in the previous section, that when pollution spillover occurs, the neighbouring districts must spend greater environmental spending, leading to positive correlation between these two variables.

Table 3-7 **Econometric estimation results: Dependent variable= (Environmental spending)**

Independent variables/	(All districts) Fixed effect	Mineral and timber producing district Group	(All districts) Fixed effects 2SLS	Neighbours are Mineral and timber producing district
	1	2	3	4
Neighbours' shared natural resource revenue	0.010** (0.005)	0.010** (0.005)	0.010* (0.006)	0.009* (0.005)
Total transfer revenue	0.024*** (0.003)	0.024** * (0.002)	0.025*** (0.002)	0.024*** (0.002)
Own-source revenue	0.086 (0.066)	0.126 (0.077)	0.113 (0.085)	0.075 (0.075)
Literacy rate	0.00003 (0.0001)	-0.00003 (0.00013)	0.004 (0.0004)	0.0003* (0.0001)
Poverty rate	-0.0003 (0.0003)	-0.00006 (0.0005)	-0.0004 (0.002)	-0.0007* (0.0003)
Population density	9.50e-08 (0.00001)	-0.00003 (0.00002)	0.00002 (0.00005)	4.31e-06 (0.00002)
RGDP	-0.0001 (0.0007)	-0.0002 (0.0008)	-0.00002 (0.0006)	-0.0001 (0.0007)
Provincial environmental spending	2.26e-08 (3.50e-07)	2.71e-08 (3.74e-07)	3.98e-07 (9.81e-07)	-5.37e-07 (6.46e-07)
Special grant for environment and forestry	-0.297 (0.631)	-0.244 (0.831)	0.354 (0.153)	0.430 (0.675)
Mineral and Timber producing district group dummy	-0.007 0.022	N/A	-0.022 (0.082)	N/A
Number observation	789	596	612	596
No. group	199	149	173	149
R^2 (within)	0.38	0.23	0.39	0.23
First stage F-test	N/A	N/A	16.23	N/A
Time controlled	Yes	Yes	Yes	Yes

Note: 1.All fiscal variables are measured in real per capita terms. Figure in bracket is standard error. The signs ***, **, and * indicate significance at 1, 5, 10 per cent respectively. Robust standard error is clustered at district level.

The econometric estimation on mineral and timber producing districts only in columns 2 and 3 consistently shows positive effects of neighbours' natural resource revenue over their districts' environmental spending. To take into account the potential endogeneity with conditional grants for the environment, the two-stage least square is applied with

the number of rainy days in a year as the instrumental variable. The special criterion for conditional grant allocation is the lagged region where rain area is one of the indicators for determining the criteria of the lagged region. The two-stage estimation shows a slightly greater effect of neighbours' natural resource-revenue sharing on own environmental spending. This finding provides evidence that neighbours' pollution spillover serves as a channel for positive spatial interactions of environmental spending.

3.4.5 Does the pollution impose cost?

The positive response of a district over its neighbours' shared natural resource revenue implies the existence of a cost it bears. One associated cost is that a district must provide greater health spending to cope with greater pollution impact. This study uses health spending to represent the environmental cost where the greater the damage, the greater the health cost needing to be covered by a local jurisdiction (Chen et al. 2016). Hence, a district's environmental spending can impose a positive externality on its neighbouring districts through affecting its neighbours' health expenditure. Previous studies (Chen et al. 2016; Narayan & Narayan 2007), have found that environmental quality plays a significant role in determining health care expenditure. The pollution spillover causes detrimental health effects to the residents of a district. It is reasonable to expect the positive correlation between pollution spillover and health spending.

Specifically, this section examines whether a district's environmental conditions have any effect on the public health spending of its neighbouring' districts. The empirical model is specified as follows:

$$h_{it} = \beta_1 \mathbf{W}\text{ij*Shared natural resource revenue}_{it} + \beta_2 \boldsymbol{X}_{it} + \rho_t + \boldsymbol{\alpha_i} + \epsilon_{it}\,, \qquad (4)$$

where h_{it} denotes a district's health expenditure, **w** represents a spatial contiguity weight matrix. X is a vector of control variables which have been used in previous studies (see

Narayan & Narayan 2007), comprising total fiscal transfer revenue, percentage of population over 65 years old, unemployment rate, percentage of people in rural area, own-source revenue, poverty rate and literacy rate. ε_{it} is an error term with E(εit) = 0 for all i. α_i denotes district fixed effects or districts' unobserved heterogeneity, and ρ_t represents the time fixed effect which accounts for government policy change which may affect the health spending size.

Table 3-8 shows the results of fixed effect estimation for health spending. Column 1 shows estimation results for all districts. The positive and statistically significant coefficient for neighbours' shared natural resource revenue implies that pollution by neighbours generates substantial losses for a district in terms of health costs. Every one million IDR increase in neighbouring districts' shared natural resource revenue leads to 23.000 IDR per capita higher health spending in own district. This result suggests and corroborates the argument that environmental quality in neighbouring districts imposes costs on own district. Fiscal transfers and own-source revenue play an important role in determining spending size as expected. However, among other demographic variables, only the percentage of population in rural areas significantly negatively affects health spending, suggesting that districts with greater sized rural areas have lower health expenditure.

Table 3-8 **Econometric estimation results: Dependent variable (Health spending)**

Independent variables	All districts	Neighbours are mineral and timber producing districts	Mineral and timber producing districts
	1	2	3
Neighbours' Shared natural resource revenue	0.023 ** (0.009)	0.024*** (0.009)	0.022** (0.009)
Total transfer revenue	0.022** (0.009)	0.015** (0.006)	0.022** (0.010)
Own-source revenue	0.274*** (0.044)	0.299*** (0.055)	0.264*** (0.036)
Literacy rate	0.0004 (0.0005)	-0.0003 (0.0003)	0.001** (0.0004)
Poverty rate	-0.002 (0.005)	-0.004 (0.007)	-0.002 (0.006)
Percentage of population over 65	-0.010 (0.067)	-0.023 (0.075)	0.0002 (0.070)
Unemployment rate	0.003 (0.006)	0.003 (0.006)	0.005 (0.009)
Percentage people in rural area	-0.003* (0.002)	-0.003* (0.002)	-0.0009 (0.0012)
Number observation	764	570	574
No. group	197	148	150
R^2 (within)	0.19	0.20	0.34
Time controlled	Yes	Yes	Yes

Note: All fiscal variables are measured in real per capita terms. Figure in bracket is standard error. The signs ***, **, and * indicate significance at 1, 5, 10 per cent respectively. Robust standard error is clustered at district level.

Column 2 in Table 3-8 shows the estimation only for districts neighbouring mineral-producing districts. The effect on the magnitude of health costs is slightly greater when the neighbours are classified as mineral and timber producing districts[25]. Following Duvivier and Xiong's (2012) findings that border jurisdiction residents are more highly exposed to pollution than inland jurisdictions, I estimate for mineral and timber producing districts only. Column 3 shows the estimation among mineral and timber producing districts with practically similar effects from neighbours' shared resource revenue on a district's own health spending.

3.4.6 Is environmental spending in mineral and timber producing districts too low?

The previous econometric estimations have found evidence of positive correlation in environmental spending among districts in Sumatera and Kalimantan Island, suggesting

[25] Districts which do not have mineral and timber producing districts are excluded from this estimation.

a district will increase its own environmental spending in response to neighbours' environmental spending. Given the low proportion of environmental spending in spending composition, and the importance of the extractive sector in the economy, the low environmental spending can be a potential channel of interaction for negative externality of spending spillover. Hence, districts with greater sized mining sectors must exert greater environmental spending to mitigate the environmental consequences caused. The lack of environmental spending makes districts unable to control environmental degradation. Worse environmental quality affects neighbouring districts and causes them to increase environmental spending to mitigate the environmental impacts.

To investigate whether districts hosting extractive industries experience a lack of environmental spending, I split the districts based on the natural resource endowment. This follows the mineral-producing criteria by the Ministry of Energy and Mining and the Ministry of Forestry. I examine whether there is a systematic difference in average environmental expenditure between the mineral and timber producing districts group and non-producing ones with a *t-test*. Because natural resource exploitation in mineral-producing districts can result in environmental problems, it is plausible to expect these districts would expend greater environmental spending than non-producing districts. However, the t-test results in a t-value of –0.33 with a p-value of 0.74, suggesting that there is no difference in environmental spending size. In this case, the average environmental spending in per capita term is 26.930 IDR per capita for mineral and timber producing districts, and 25.865 IDR per capita in non-producing districts.

This suggests that although mineral and timber producing districts increase their environmental spending every year, the size of the increase does not cover the environmental conservation needed. One potential explanation for the lack of

environmental spending follows Qian and Roland (1998), that under a fiscal decentralization system, capital competition among local governments motivates them to provide growth-promoting infrastructure and not to offer socially inefficient services.

Despite the lack of environmental spending in mineral-producing districts, this study does not argue that non-mineral and timber producing districts have allocated appropriate amounts of environmental spending. One important point is that the statistically insignificant difference in environmental spending between these two types of districts suggests that the lack of environmental spending makes the mineral-producing districts unable to mitigate the environmental consequences associated with the extractive sector.

3.5 Conclusions and policy implications

This study finds positive and significant spatial interaction in environmental spending decisions among local governments in Sumatera and Kalimantan Island. The presence of pollution spillover, proxied by neighbours' shared natural resource revenue, serves as the channel for positive spatial interaction. When a district suffers from pollution spillover from neighbouring districts, it must exert greater environmental spending to mitigate the impacts.

This study provides evidence that neighbours' pollution levels are strongly associated with increases in a district's health spending. The lack of environmental spending in mineral and timber producing districts makes these districts unable to overcome the environmental consequences effectively. It worsens the environmental problems and adversely affects its sharing border-neighbours, forcing the neighbouring districts to add extra environmental spending to counteract the worse environmental impact.

The fact that spatial interdependence plays an important role in the setting of environmental policy and the lack of environmental spending may pose challenges for local governments in paying for environmental conservation. To ensure local governments play their strategic role in conserving the environment, central government can do some policies, including (1) providing greater support to local government to address better environmental protection efforts, (2) taxing the polluter consistent with its cross-border impact and using these monies to compensate the “victim” jurisdiction and (3) adopting a Coasean solution between the polluting and the victim jurisdictions for the polluter to make such a compensation without any central government involvement.

4. EVALUATING THE EFFECTS OF REGIONAL INCENTIVE FUNDS TO DISTRICT GOVERNMENTS IN INDONESIA

Abstract

This study aims to examine whether the recipients of Indonesian government's fiscal incentive, Regional Incentive Fund, increase their education spending. The concern of likely perverse impact of intergovernmental fiscal transfer on local governments' fiscal behavior has motivated this study. Using difference in difference approach for three periods of analysis, 2009–2010, 2009–2011 and 2009–2012, this study finds evidence that the RIF allocation has positive impact on education spending in recipient districts. However, the increase in education spending is smaller in the subsequent years. The smaller increment in education spending suggests the potential presence of the fungibility, where the recipient local governments substitute their budget for education spending with the money from the RIF. This study highlights the importance of designing the appropriate conditionalities embedded in the fund.

4.1 Introduction

The Indonesian government has put great attention on the education sector and allocated significant fiscal transfers to promote the education sector at the local level. In addition to conditional grants for the education sector, the fiscal incentive provision through the Regional Incentive Fund (abbreviated as RIF in this paper) has been allocated to selected local governments. Through this incentive, the central government helps to promote greater investment in the education sector. However, the literature indicates negative effects of fiscal transfers on local governments' fiscal behaviour (Gamkhar & Shah 2007; Shah 2007). Due to the fungibility of grants, diversion of transfer funds to other unintended spending is commonly found and will dampen the effectiveness of the fiscal transfers. Hence, carefully designed fiscal transfers are crucial to successfully achieving the objectives of the fiscal transfers

Central government, as the grantor of money to local governments, demands optimum output from the transfer, which requires recipient local governments use the funds with high effectiveness in supporting their education spending. This can be done by conditioning or earmarking fiscal transfers with certain criteria or reference to ensure proper use. For RIF, it is tied to the education function. Despite the conditions imposed, both on access to and use of the funds, previous studies in the literature suggest the potential of fungibility in conditional grants (see Smart & Bird 2009; Shah 2007; Islam 1998). The presence of fungibility can lower the provision of public services because the reallocation of funds does not increase the targeted spending (see Dieleman et al. 2015).

Given its features, the regional incentive fund can be classified as a conditional block grant, where recipients have discretion over the use of the fund. This grant is earmarked to education spending of recipients. Since its introduction in 2010, the central

government had allocated more than one trillion IDR of RIF every year. On average, each RIF recipient district receives almost 20 billion IDR every year of allocation, which is slightly lower than total conditional grants for the education sector, amounting to 22 billion IDR per district. For some districts this amount is almost the same size as their own-source revenue, or around 4% of total fiscal transfers, and around 3% of total revenue. The Binjai city collected around 19 billion IDR from its own-source revenue but received 21 billion IDR from RIF in 2010. Interestingly, Jombang regency received RIF in three consecutive years, 2010, 2011 and 2012. Compared to other RIF recipients, the amount of RIF this district received remained around 19 billion IDR, but the percentage of RIF over own-source revenue declined from around 17% in 2010 to 12% in 2012[26].

Whether this type of transfer can successfully achieve its expected target, leveraging investment in the education sector, is mostly unknown. In particular, the presence of fungibility can hamper the optimum benefit of this fund. Given the significant amount of money compared to other types of conditional transfers, and the strategic role of the education sector in promoting economic development, government needs to ensure that the recipients use this transfer effectively. Hence, this study aims to investigate whether RIF encourages recipients to make greater education expenditure[27]. The findings of this study will highlight whether this earmarked grant model is effective in promoting greater education spending.

Because the composition of RIF recipients is changing every year of allocation, the estimation is conducted for each year of allocation to ensure the consistency of the estimation for education spending by RIF recipients. Using a difference in difference

[26] The consistent increase in own-source revenue contributed to the ability of Jombang regency to maintain its recipient status.

[27] The RIF can only be used to support the recipients to perform their education function, which has broad coverage. This education function does not only cover school and student related expenditures, but also for non-students, such as training for drop out children and for literacy program for the elderly.

approach, this study analyses three periods of RIF allocation, 2009–2010, 2009–2011 and 2009–2012, where 2009 is treated as the baseline year, and other years serve as the allocation year of RIF or treatment year. By splitting the analysis by period of allocation year, this can maintain consistency of analysis and find the increment of education spending for every year of allocation. By looking at how education spending increases in RIF recipients, the issue of fungibility can be investigated (see van de Walle & Mu 2008; Gordon 2004). The findings of this study can contribute to enrich the literature on fiscal transfer design which is still limited for the case of Indonesia, and provide an analysis to the Indonesian government for use in designing its fiscal incentives to local governments.

This paper is organized as follows. Section two provides a literature review about conditional fiscal transfers and fungibility. The third section elaborates fiscal transfers in Indonesia and section four elaborates the regional incentive fund. Section five focuses on data and methodology and is followed by interpretation. Section six discusses the results and output-based fiscal transfers. Section seven provides conclusions and policy considerations.

4.2 Literature review

One dimension of fiscal decentralization is concerned with the degree of spending autonomy granted to local governments in financing local governments' public services. Three types of transfers are commonly found in practice, general purpose transfers, specific or special purpose transfers, and sectorally limited block allocations (Schroeder & Smoke 2002). General purpose grants or unconditional grants enlarge local governments' resources and impose no specific purposes. This type of transfer is classified as a non-earmarked transfer or grant, where local governments can use them based on their discretion. By contrast, with conditional or earmarked transfers, central

government can ensure local governments use the funds as expected to achieve national service delivery targets in certain sector areas, such as education and health, and ask local governments undertake specific programs in implementing national programs. Smart and Bird (2009) distinguish earmarked transfers into three classifications, (i) open-ended matching for which the transfer amount paid is a fixed share of the amount spent on assisted spending, (ii) closed-ended matching grants earmark spending to certain limits, and (iii) categorical block grants, which are conditional on the recipient government meeting certain conditions with respect to its spending in the targeted category. Sectorally limited block allocation allows the recipient government to choose how funds are to be used, but only within a particular sector; hence this transfer is less restrictive than specific transfers. Therefore, this transfer can be classified as a conditional grant.

Both earmarked and non-earmarked grants can be either mandatory or discretionary (OECD 2006). Mandatory grants are ruled by laws and lay out specific size and rules-based obligations for central government to provide this type of grant. Under the discretionary basis, the sizes of discretionary grants, and the conditions under which they are given, are decided on an ad hoc basis. Discretionary grants are often temporary and are not usually aimed at addressing fiscal imbalances.

Unconditional and conditional grants can have perverse effects on local governments' fiscal behaviour. Although unconditional transfers provide greater flexibility for local governments to use, they can dampen local revenue mobilization and local spending, called the flypaper effect (Smart 2007). Similarly, conditional transfers do not guarantee local governments' greater spending due to the fungibility effect. Hence, the proper design of fiscal transfers is crucial to ensure efficient service delivery. As Smart (2007)

argues, the results of intergovernmental grants, whether they are positive or negative, depend on the incentives embedded into the grants system.

4.2.1 Fungibility in intergovernmental fiscal transfers

In order to get local governments to implement specific programs with high national priority, the central government provides special fiscal transfers aimed to support local governments to implement the programs. However, different objectives and preferences between central government and local governments, as recipients of fiscal transfers, can lead to unintended use of the fiscal transfers. Local governments reallocate certain fiscal transfers, intended to support national priorities, to other spending which is considered to have greater priority at local level, leading to fungibility, Hence, the fiscal transfer is fungible when it substitutes rather than supplements local spending.

The World Bank (1998) states that fungibility is less likely to occur when the amount of aid is large relative to the recipient's budget. In line with this argument, Shah (2006) posits the fungibility of conditional grants depends on both the level of spending on the assisted public service and the level of priority of the assisted spending. If the recipient’s own-financed expenditure exceeds the amount of the conditional grant, the conditionality of the grant may not influence the recipient’s spending behaviour.

Concern about fungibility emphasizes the importance of conditioning or earmarking grants to ensure effectiveness. Information asymmetry between central and local governments, risk mitigation, coordination efforts among tiers of governments, and the promotion of performance of lower governments are some reasons which support the need for conditionality (Spahn 2012). In the context of international aid, Collier et al. (1997) identify four rationales for conditionality: (a) inducement, where the donor offers aid as an incentive to reform the recipient’s policies, (b) paternalism, where the donors believe they know the right policies for the recipient’s welfare, (c) restraint, the need for

instruments to safeguard the commitments of recipients, (d) signalling, indicating commitment to reform.

Two theoretical approaches have been used to conceptualize conditionality (see the World Bank 2005). The first approach is through a principal-agent framework where the principal offers a contract that provides the agent with an appropriate incentive to align their respective objectives but the agent has private information on the ability, opportunities, and intentions that affect the action it takes and ultimately the principal's objective. In this framework, the principal (the central government) can unilaterally alter any existing arrangements it may have with its agents (local governments) in order to overcome familiar agency problems of information asymmetry and differences in objectives between its agents and itself.

The second approach is through the political economy framework. The imposition of conditionality is needed to counteract domestic conflicting interests between the government and special interest groups. These groups can affect the government's ability to use reform through several actions, such as strikes. In this framework, the central government (as the donor) needs to bind local governments with a set of rules which ensure the local governments allocate the transfers to targeted sectors or activities. The practice of collusion is commonly found in project procurement which involves parties close to local government officials.

The same principle also applies in the area of intergovernmental fiscal transfer. Bird and Smart (2002) suggest that conditionality must be attached in the fiscal transfer feature. The main motivation to add conditionality in transfer design is money fungibility[28].

[28] Morrissey (2006, p. 334) distinguishes three elements of fungibility: (i) general fungibility, which arises where aid intended for a general purpose is used for another (for instance, consumption instead of investment expenditure); (ii) categorical fungibility, describing the use of aid intended for a particular sector or budget heading for another, for example, use on defence instead of health; and (iii) additionality, which describes the possibility that even if aid resources are used for the intended expenditure, they might

There is no guarantee the recipient local governments will in fact use the funds they receive as the central government might wish. Therefore, some conditionalities are often desirable to ensure the proper use of fiscal transfer funds. This is in particular for national priorities, including education and environment, which are delivered by local governments. The introduction of conditionalities is applied for conditional grants which can bring elements of local involvement, accountability and responsibility. Bird and Smart (2002) suggest the use of matching components as conditionality.

The literature in public finance suggests two types of conditionality can be imposed in conditional or earmarked fiscal transfers. Input-based conditionality specifies the type of expenditure that can be financed, and output-based conditionality requires the attainment of a certain level of service delivery (Shah 2009). However, input-based conditionality is considered to be unproductive because it distorts local government priorities. On the other hand, an output-based model conditions the transfer on the results to be achieved. Local governments have discretion in the activities implemented using the transfer monies, but they must achieve certain output-related measures.

Although the purpose of making fiscal transfers conditional is to ensure the intended use, previous studies have found fungibility in conditional grants (see Duan & Zhan 2011; Wagstaff 2008; Gordon 2004; Islam 1998). The findings of these studies suggest that the right design of conditionalities is needed to ensure the effectiveness of fiscal transfers. The lack of effectiveness of input-based conditionality has highlighted the importance of monitoring the targeted sector or spending. As Morrissey (2006) argues, conditionality should not be the focus, but it should be on monitoring of the effectiveness of spending. The lack of monitoring on the use of grants opens opportunities for fungibility. Chatterjee et al. (2007) argue that the high cost of

free up the recipient government's own resources allocated to that area to be used elsewhere so that allocations to the intended purposes do not increase by the full amount of aid.

monitoring drives greater potential for fungibility. The literature on intergovernmental fiscal transfers has suggested linking fiscal transfers with certain measurements or performances to ensure effectiveness (see Shah 2007, 2010). In this way, central government can monitor the results of transfers and ensure the effectiveness of the transfers.

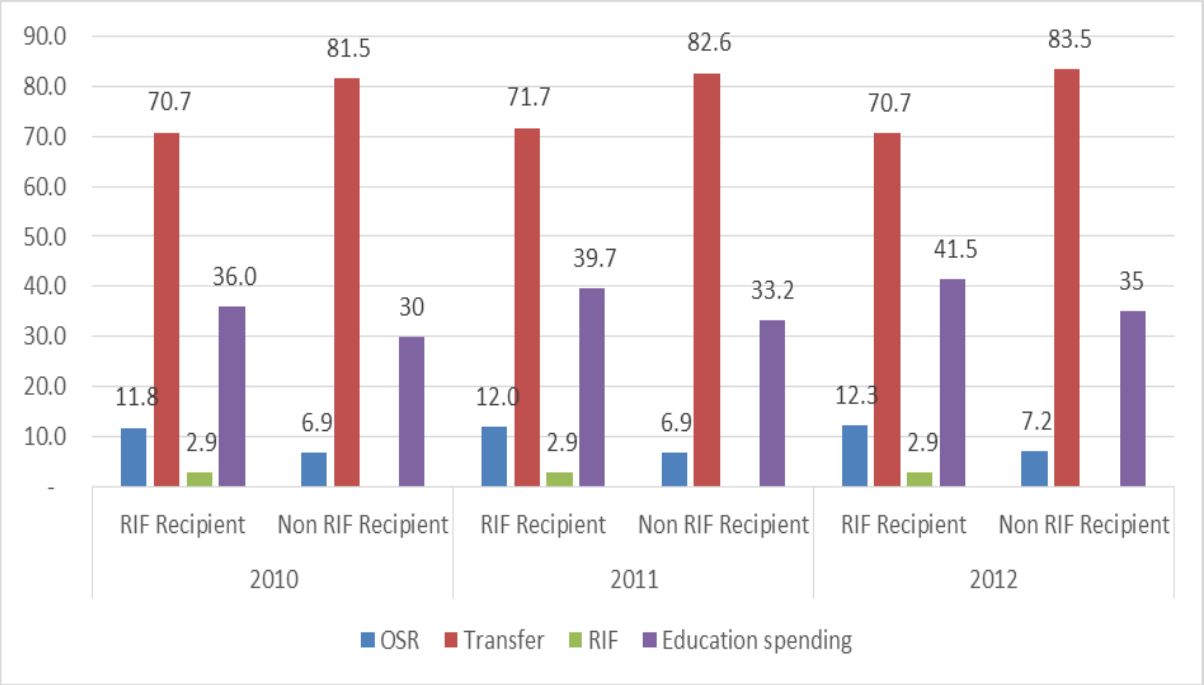
4.3 Fiscal Transfer in Indonesia

In general, there are two types of central government transfers to local governments in Indonesia. They can be done through balancing funds and adjustment funds. Unlike the balancing fund, which aims to reduce horizontal and vertical inequality in fiscal capacity among layers of governments, the adjustment fund serves as an additional support to local governments by taking into account the strategic nature of certain regions and sectors. The balancing funds are the major source of revenue for local governments, averaging 80% of total revenue. Figure 4-1 below shows trends in the size of each type of revenue source in RIF recipients and non-recipients.

The average composition of fiscal transfers in RIF recipients accounts for 70% of total revenue, which is lower than non-recipients, accounting for around over 80%. This suggests significant transfer dependency in non-RIF recipients. The average own-source revenue over total revenue is higher in RIF recipients compared to non-RIF recipients, accounting for 12% and 7% respectively. With regard to spending size, the composition of education spending over total spending in RIF recipients is greater than non-RIF recipients. In 2010, education spending accounted for 36% in RIF recipients, which is greater than non-RIF recipients accounting for 30%. However, the increase in education spending has been slowing down in RIF recipients. From 2010 to 2011, education spending increased from 36% to 39.7%, almost 4%, compared to around 3% in non-RIF recipients. From 2011 to 2012, the increment in education spending between RIF and

non-RIF recipients was practically identical, around 2%. On the other hand, the size of RIF over total revenue in RIF recipients is quite significant, accounting for 3% of total revenue.

Figure 4-1 **The composition of revenue and education spending in RIF and Non-RIF recipients**



Source: Own calculation based on MoF data. Education spending is the percentage of total spending.

4.4 Regional Incentive Fund

The Indonesian government has invested sizable funding in the education sector to enhance the quality of its human capital. The commitment to education was realized by passing a constitutional mandate to allocate at least 20 percent of the total government budget to the education sector. Law number 20/2003 about the National Education System requires governments to allocate at least 20% of their budget for education spending. Table 4-1 displays the average ratio of education expenditure over total spending. The average ratio of education spending accounts for 36% in RIF recipients, which is greater than non-recipients, accounting for 29% in 2010. The ratio was still greater in RIF recipients in 2012.

Table 4-1 **Average education spending over total spending (in million IDR per capita)**

Group	2010	2011	2012
RIF recipients	0.36	0.38	0.39
Non-Recipients	0.29	0.33	0.35

Source: Own calculation based on data from Indodapoer and MoF.

The World Bank (2013) reports that with the 20% rule, the percentage of education spending over total spending makes Indonesia one of the top spenders among peer countries, such as Norway and Singapore. However, in terms of total gross output, at 3.7 per cent of GDP, Indonesia spends less than Thailand, Vietnam or Malaysia in the region, and spends half as much as high-income, high-performing countries such as Norway. There is concern about a greater portion of education spending going to primary education.

Dana Insentif Daerah or Regional Incentive Fund (RIF), is a type of transfer, called an adjustment fund, allocated to certain regions taking into account certain criteria to perform the functions of education. This fund aims to provide broad support in the education sector while the recipients have discretion in allocating its use to specific purposes, as long as it is supporting the education function. The expenditure falling into the education function covers a broad area, from formal education to non-formal. The formal sector includes primary to high school education. On the other hand, non-formal education includes programs such as vocational training, literacy programs for elders, and life skills training. The literature recognizes this transfer as a block grant, where it

provides budget support with no strings attached in a broad but specific area of subnational expenditure.[29]

Among central government's fiscal incentives to local governments, only *Dana Insentif Daerah* or Regional Incentive Fund (RIF) clearly specifies criteria for grant eligibility. This model adopts a selectivity model where local governments with better scores or indexes will be eligible for RIF. These criteria apparently serve two functions, (i) to incentivize local governments to compete to produce good performance, as shown by the good score for each indicator, and (ii) to screen eligible recipients in a more objective approach. Hence, a local government must meet the aggregate criteria or indicators and rank highly to be eligible for this transfer. The benefit of the multi indicators approach is that central government can target local governments' better public services in specific areas. In the literature, this approach is known as a 'selectivity index', rewarding local governments to race to the top. Zinnes (2009) coins this approach as pure tournaments, as while all eligible players may compete, only those with the best performances win the rewards.

At the first introduction, certain criteria are defined as the basis for determining the receiving area and calculating the amount of the allocation of RIF, covering an area of achievement that meets the criteria of financial and economic performance and welfare, as well as considering clean and good governance. The criteria set out include primary criteria and performance criteria and the provision of a minimum allocation. The primary criteria include at least getting a qualified opinion from the financial audit office, and timely annual budget approval. The performance criteria include financial

[29] In literature, the regional incentive fund can be classified as block grant, where the recipients are granted discretion over the use of the fund as long as the fund used for education sector. However, the demarcation between block grant and conditional grant is vaguely defined (Shah 2006). For the analysis, I consider RIF as conditional grant.

performance criteria, education performance, economic and welfare performance criteria.

Financial criteria are established to assess regions' performance. The criteria include the capacity to improve and maintain the quality of local government finance reports from the Audit Board, the timely completion of annual regional budgets, increasing own-source revenue above the national average, and conveying local government finance reports to the Audit Board in a timely manner each year.

The education performance criteria are defined as an element of assessment of the performance and efforts of the education sector. The criteria is the districts which are able to achieve gross elementary enrolment above the national average and/or areas that are able to achieve a Gross Enrolment Ratio in Junior Secondary above the national average, and districts which are able to reduce their distance on the Human Development Index from the Human Development Index base (100) above the national average.

Economic Performance and Welfare are the established criteria as an element of assessment of the economic growth rate which is above the average rate of national economic growth, the reduction in the poverty rate above the average national poverty reduction, reduction of the unemployment rate above the average national unemployment rate reduction, and the higher Human Development Index above or below the national average.

The regional incentive fund is not classified as a type of balancing fund, but serves as a reward for well-performing districts and provides incentives to support recipients in performing the education function. The use of this fund is not only aimed at providing better school infrastructure, but also improving non-student and school spending. The

city of Gresik allocated funding for school renovation and built new schools for both private and public schools. The city of Yogyakarta used this fund to provide training for youth labour to support business development.

Unlike other types of fiscal transfer, the regional incentive fund (RIF) is allocated to only the selected local governments and is earmarked for restricted use in the education sector only. The use of this approach follows previous studies suggesting the need to earmark the fund with conditionality to reduce the fund's fungibility. RIF provision aims to encourage regions to manage their finances better, as demonstrated by the acquisition of Audit Board opinion on the financial statements of local government, and to encourage the region to strive to budget in a timely manner. This transfer is considered a reward from central government to recipient local governments for above-standard performance, both economic and social performance. This incentive is intended to support education expenditure, or other types of spending related to education. Activities which cannot be financed by this incentive include matching funds for Special Allocation Grants or *Dana Alokasi Khusus* (DAK), DAK-financed activities, School Support Assistance, bureaucratic training, and grants to locally owned companies. Hence, this transfer is allocated through an ad hoc model and can be classified as a specific transfer.

The RIF has allocated more than 1 trillion IDR every year, with each recipient receiving around 20 billion IDR. It is apparent that to maintain this significant amount, the fund is allocated to only a few districts, which are strictly selected. Table 4-2 shows the increase in RIF in 2011 compared to 2010, from 960 billion IDR in 2010 to more than 1 trillion IDR in 2011. The number of recipients also increased in tandem with the increase in RIF allocation, from 45 in 2010 to 55 in 2011.

Table 4-2 **The development of RIF allocation**

Year	District/Municipalities		Provinces		Total	
	Number	Amount (in IDR trillion)	Number	Amount (in IDR trillion)	Number	Amount (in IDR trillion)
2010	45	0.9	9	0.3	54	1.2
2011	55	1.2	5	0.2	60	1.4
2012	55	1.2	10	0.2	66	1.4

Source: Audited fiscal transfer report for various years
Note: Figures in IDR are rounded

4.5 Data and Methodology

The analysis draws mainly on three sources of data. At the core is the panel data on Indonesian local governments' public finances, which is obtained from the Directorate General of Finance Balance at the Ministry of Finance. This study also benefits from the World Bank INDODAPOER database and Statistics Office publications for various years. All economic and fiscal data are real term data, where nominal data are deflated by each district's RGDP deflator. Districts are defined as the third level of government, the *kabupaten* or regency, and *kota* or municipality. Special Region Jakarta is excluded from the sample.

The variables used for analytical purposes are listed in Table 4-3 and split into RIF recipient and non-RIF recipient districts. The districts included are those which existed between 2009 and 2012. This table provides summary statistics for all variables used in the analysis. Spending, transfer and economic variables are in rupiah. Table 4-3 indicates significant differences in both education spending and eligibility variables. The average education spending per capita in RIF recipient districts was 392.301 IDR for the period 2009–2012. The recipient districts had a greater average increase in own-source revenue, audit opinion status, and poverty rates. Smaller gaps with ideal values on the Human Development Index were found in RIF recipients. This description

appears to give early insights into positive effects of education spending in RIF recipient districts.

Table 4-3 **Descriptive Statistic (2009–2012)**

Variable	**RIF Recipient**					**Non-RIF Recipient**				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Education spending	155	0.401	0.249	0.066	1,502	1741	0.363	0.462	0	13,707
Total transfer	155	0.924	1.342	0.151	12.543	1778	1.268	2.031	0.046	34.472
Own-source revenue Increase (%)	155	24.45	28.89	–53.11	168.67	1778	24.02	51.20	0.3	231.2
RGDP Per capita (in IDR million)	155	8.68	6.68	1.71	47.48	1778	8.03	11.01	0.89	173.11
Audit opinion	155	2.9	0.4	1.0	3.0	1778	2.5	0.8	1.0	3.0
HDI gap	142	–38.6	27.8	–100	–19.49	1789	–40.2	26.3	–100	20
Economic growth (%)	155	7.2	2.2	2.7	18.9	1775	5.9	8.7	0.7	120.57
Timeliness of delivery of approved budget	155	1.8	2.4	1	3	1778	2.1	2.6	1	3
Poverty rate decline (%)	155	–0.54	0.87	–3	2.85	1785	–0.74	4.32	–29.17	47.82
Unemployment rate gap	155	–0.40	1.3	–6.9	4.3	1753	–0.33	3.85	–88.52	52.79
Student enrolment rate	152	92.2	3.7	77.2	99.25	1731	92.2	8.2	6.6	100
People 15–64(% of population)	155	83.4	65.6	75.5	96.0	1775	94.3	56.6	89.2	98.6
People in urban (%)	155	55.5	34.4	0.0	100.0	1775	34.3	30.4	0.0	100.0
Population	155	630671	585342	62580	2765487	1778	458564	553353	6144	4989939

Note: Education spending and total fiscal transfer are measured in IDR million in constant (2000) per capita terms, converted using the implicit GDP deflator.

4.5.1 Methodology

It is an objective of policy makers to ensure that programs are designed to achieve expected outcomes in an effective manner. The central impact evaluation question is

what would have happened to those receiving the intervention if they had not in fact received the program. Hence, the basic question is whether the participants in the program, or the treated group, achieve expected outcomes.

Estimating the impact of a program only on a treated group will make a biased estimation because the results are independent of other factors which may affect the result, and there is non-randomness. Random treatment is crucial to ensure to avoid self-selection bias and other factors which may affect the selection of program participants, called purposive program placement (Khandker et al. 2010, p.25). For selection of RIF, districts' participation is not random, because the selection is based on certain indicators. Hence, districts with better scores have a greater chance of participating in the program. Estimating the effect of participation in the RIF program is confounded by possible correlation between outcomes and the district's economic and financial performance. It has also been argued that selection bias would disappear if one could assume that whether or not households or individuals receive treatment (conditional on a set of covariates, X) was independent of the outcomes they have. This assumption is called the assumption of unconfoundedness, also referred to as the conditional independence assumption (Rosenbaum & Rubin 1985).

To address the problem of selection bias, one needs to compare the situation of a treated group against a situation where the program had not existed, called a counterfactual. However, we cannot observe two situations simultaneously. Hence, we need to create a convincing and reasonable comparison group for the treated group. This comparison group or control group has similar characteristics to the treated group, such that the outcome of the treated group would be similar to the comparison group in the absence of treatment. Hence, the crucial role of the control group is to mimic the treated group if the treated group had not been exposed to the program. The literature recognizes several

approaches to identifying a control group for a program. The most widely used type of matching is propensity score matching, in which the comparison group is matched to the treatment group by using the predicted probability of participation given observed characteristics, called the propensity score. This method allows one to find a comparison group from a sample of non-participants closest in terms of observable characteristics to a sample of program participants.

An estimate of program impact can then be derived by comparing the levels of expected outcomes between comparison/control groups and the treated group. It is possible to apply a framework with two potential outcomes Y^T, an outcome for treated districts, and Y^C representing the control group, or group which does not receive the incentive. The observed outcome for individual district *i* can be written as $Yi = Ti Y_i^T + (1-T_i) Y_i^C$, where $T \in \{0,1\}$ indicates treatment status, with T=1 if treated and 0 if non-treated.

This study uses difference in difference (DiD) methodology to evaluate the impact of RIF. DiD essentially compares treatment and comparison groups in terms of outcome changes over time relative to the outcomes observed for a pre-intervention baseline. The difference is calculated between the observed mean outcomes for the treatment and control groups before and after program intervention. A simple framework to estimate program impact with difference in difference approach can use the following matrix:

Group	Base year	Treated year	Difference
Treated group (1)	Y_0^T	Y_1^T	$\Delta Y^T = Y_1^T - Y_0^T$
Control group (0)	Y_0^C	Y_1^C	$\Delta Y^C = Y_1^C - Y_0^C$
Difference			$\Delta\Delta Y = \Delta Y^T - \Delta Y^C$

The DiD approach compares outcomes between treatment and comparison groups over time relative to the outcomes observed for a pre-intervention baseline. That is, given a two-period setting where t = 0 before the program or baseline, and t = 1 after program implementation, letting Y_t^T and Y_t^C be the respective outcomes for a program treated and non-treated groups in time t, the DiD method will estimate the average program

impact as follows: DiD= $E(Y_1^T - Y_0^T \mid T=1) - E(Y_1^C - Y_0^C \mid T=0)$, where T denotes 1 for treatment, and 0 for non-treatment.

Following Angrist and Krueger (1999), the rationale of the difference in difference approach lies in terms of restrictions on the conditional mean function for potential outcomes in the absence of the program. Let Y_{0i} be district i's education spending in the absence of the regional incentive fund (RIF), and Y_1i be i's education spending with the presence of RIF. The DiD method identifies causal effects by restricting the conditional mean function of district i in time t, $E[Y_{0i} |i, t]$. Suppose that $E[Y_{oi} (i,t)] = \beta_0 + u_i$, that is, in the absence of RIF, education spending can be written as the sum of a year effect that is common to all districts and a district effect that is fixed over time. Suppose the effect of RIF on audit opinion is simply to add a constant (γ) :$E[Y_1i (i,t)] = E[Yoi (i,t)] + \gamma$.

Hence, the audit opinion between the treated and control groups between two periods can be written as:

$Y_{it} = \beta_0 + \beta_1 T_i t + \beta_2 T_i + \beta_3 t_i + \varepsilon_{it}$;

where T is the dummy of treated districts, t is a time dummy variable suggesting the change in expected outcome over the periods, and the coefficient of the interaction of T and t gives the estimate of the impact of treatment on outcome Y. The expected change due to intervention in the econometric model can be decomposed as follows:

Group	Base year	Treated year	Difference
Treated group (1)	$\beta_0 + \beta_2$	$\beta_0 + \beta_1 + \beta_2 + \beta_3$	$\Delta Y^T = \beta_1 + \beta 3$
Control group (0)	β_0	$\beta_0 + \beta_3$	$\Delta Y^C = \beta_3$
Change			$\Delta\Delta Y = \beta_1$

Unlike the control group, which consists only of an initial condition in a base year, the treated group includes both initial condition and intervention status. In a treated year, the expected change of outcome in the control group consists of the initial condition and the policy carried out during the period of interest. For the treated group, the expected

change in the mean outcome consists of the intervention effect and the time effect. The total effect is shown by the interactive variable between the year and a treatment dummy, which is the variable of interest. This interaction variable suggests the treatment effect of the program. Hence, β_1 is the causal effect of the program over the expected outcome, or similar to $\beta_1 = (Y_1^T - Y_0^T) - (Y_1^C - Y_0^C)$.

To account for endogeneity from unobserved effects, this model can be estimated with fixed-effects regression controls for households' unobserved and time-invariant characteristics that may influence the outcome variable. A fixed-effects or difference estimator can account for such unobserved heterogeneity, and observed heterogeneity can also be accounted for through methods such as propensity score matching before making the pipeline comparison (Galasso & Ravallion 2004).

Propensity score matching (PSM)

The changes over time in the outcome indicator will result in heterogeneity in observables, which would bias an unmatched difference in difference approach (Ravallion 2003). Hence, combining PSM for selecting the comparison group with DiD can reduce the bias found in other evaluation methods, including single difference matching. This approach constructs a comparison group by modelling the probability of participating in the program on the basis of observed characteristics unaffected by the program. The propensity score of each district is obtained from a probit estimation depicting the probability of receiving RIF (treated group) given the explanatory variable vector. The treated districts are matched with non-treated districts based on the estimated propensity score; the closer the score, the better the match:

PS (i) = Probability (Treated district) = 1 $\mid$ $\boldsymbol{X}$ = i

where $\boldsymbol{X}$ is a vector of pre-exposure control variables which determine the probability of receiving RIF.

These explanatory variables are employed to explain the characteristics of districts which can be classified as treated districts. The variables used in the matching procedure are based on variables in the selection criteria in determining RIF eligibility. Applying PSM could help match treatment units with observationally similar control units before estimating the DiD impact. Specifically, the PSM estimates the base year and then conducts a DiD on the units that remain in the common support. Studies show that weighting the control observations according to their propensity score yields a fully efficient estimator (Hirano, Imbens, &Ridder 2003).

The three important assumptions in the PSM approach are the Conditional Independence Assumption (CIA), which follows unconfoundedness, and common support. Common support requires the positive predictability of participation for both groups given X is as follows: $0 < P(T = 1|X) < 1$. It ensures that persons with the same X values have a positive probability of being both participants and non-participants (Heckman, LaLonde, and Smith 1999). Hence, the validity of PSM depends on two conditions: (a) conditional independence (namely, that unobserved factors do not affect participation) and (b) sizable common support or overlap in propensity scores across the participant and nonparticipant samples.

The core assumption to identify the treatment effect in difference-in-difference estimators is the so-called common trend assumption or parallel path, which posits that the average change in the comparison group represents the counterfactual change in the treatment group if there were no treatment. In other words, that the average change in outcome for the treated group in the absence of treatment equals the average change in outcome for the non-treated.

4.5.2 Econometric estimation results

Before estimating the impact of RIF on education spending with the DiD method, propensity score matching is conducted to derive a control group to ensure that the control group is comparable to treatment group on which it is based. Non-recipient districts whose propensity scores are within similar ranges as recipient districts are considered as the matched comparison. The propensity score is a measure of the probability of a district to receive the RIF. The score is estimated on the set of observable covariates, which determine the propensity to receive RIF. Hence, districts with better criteria have greater propensity scores and greater probability of receiving the funds. Because the RIF eligibility criteria and scoring system are clearly defined, the unobservable covariates do not influence the probability of receiving RIF[30].

The propensity score is derived by regressing the eligibility variables in the base year for non-RIF recipients. The variables used are audit opinion, the timeliness of the annual budget report, the change in poverty rate, own-source revenue, the Human Development Index, unemployment rate, economic growth and student enrolment rate. Over three consecutive years of annual planned budget reporting, districts are scored 1 for timely reporting, and 0 for late submission. The ideal value (100) applies for HDI, and the national average standard applies for student enrolment rates and unemployment rates. The growth variable applies for own-source revenue and economic output (economic growth). The gap from the national average applies for HDI, student enrolment rates, and poverty rates.

The next step in propensity score estimation is to check if the balancing property is satisfied. The propensity scores of receiving RIF for non-RIF recipient districts are grouped with a similar range of propensity scores with RIF recipients or treated

[30] One potential unobserved covariate is the subjectivity of financial audit results. However, given the professionality of the auditors, this assumption can be neglected.

districts. Districts in a similar group or block have similar characteristics for receiving the RIF. This ensures that the same treatment and control observations are compared. Hence, we can use non-recipient districts with similar blocks as recipient districts as control groups. Those districts whose scores fall out of the range are dropped. The PSM is conducted through districts in the base year, the year 2009, for every period of analysis. The periods of analysis include 2009–2010, 2009–2011 and 2009–2012.

For 2009–2010 45 districts received RIF and 440 did not receive the RIF as shown in Table 4-4. The PSM estimation excludes 78 non-RIF recipient districts in the base year and split the score into three blocks. The t-test value suggests that the scores between recipients and non-recipients (in 2010) were not different. In block 3, the estimation does not find a match between recipients and non-recipients. The PSM estimation result shows that the propensity score balancing property is satisfied and non-recipient districts with propensity scores falling into a similar range as the treated districts are treated as a control group.

Table 4-5 shows that the PSM estimation drops 402 non-recipient districts for the period of 2009–2011 with three blocks of propensity scores ranges. 28 non-RIF recipients are excluded and 402 districts are used for control groups for DiD estimation for the period of 2009–2011. Table 4-6 shows PSM estimation for the period 2009–2012. 69 non-treated districts in the base year are dropped and only 361 districts are used as a control group in this period. The t-test value confirms the propensity score average in each block is not different. The sizable unit in the control group has met the common support assumption.

Table 4-4 **Propensity score balancing property-2009–2010**

Block	Group	Observation	Mean	t-test
1	Control	329	0.089 (0.002)	
	Treated	30	0.095 (0.007)	t = –1.55
2	Control	33	0.264 (0.008)	
	Treated	13	0.244 (0.009)	t = 1.32
3	Control	0	n.a	n.a
	Treated	2	n.a	n.a
Total	Control	362		
	Treated	45		

Table 4-5 **Propensity score balancing property-2009–2011**

Block	Group	Observation	Mean	t-test
1	Control	361	0.123 (0.001)	
	Treated	36	0.122 (0.005)	t = 0.112
2	Control	40	0.299 (0.004)	
	Treated	18	0.318 (0.008)	t = –1.62
3	Control	1	n.a.	n.a
	Treated	1	n.a	n.a
Total	Control	402		
	Treated	55		

Table 4-6 **Propensity score balancing property 2009–2012**

Block	Group	Observation	Mean	t-test
1	Control	349	0.123 (0.001)	
	Treated	52	0.125 (0.004)	t = –1.2656
2	Control	12	0.243 (0.010)	
	Treated	3	0.212 (0.034)	t = –0.892
3	Control	0	n.a	n.a
	Treated	1	n.a	n.a
Total	Control	361		
	Treated	55		

Difference-in-difference estimators assume that in the absence of treatment the difference between control and its counterfactual groups would be constant over time. Although the counterfactual is not observable, the derived control group from propensity score serves as counterfactual. Following Gertler et al. (2011), one way to assess the common trend by comparing changes in outcomes for the treatment group and comparison groups before the program is implemented. If the outcomes moved in tandem before the program started, we can believe that outcomes would have continued to move jointly in the post-intervention period.

Testing this assumption, I graph the trend of education spending per capita to estimate whether there is any difference in education spending prior to respective RIF allocation year. Figure 4-2 to 4-4 display the common trend starting from 2007 to each year of RIF allocation. In the graphs of common trend, generally they do appear to be relatively similar trends in the previous years prior to RIF allocation. These results give credibility to the control group selection.

Figure 4-2 **Parallel path 2007–2010 (Education spending per capita)**

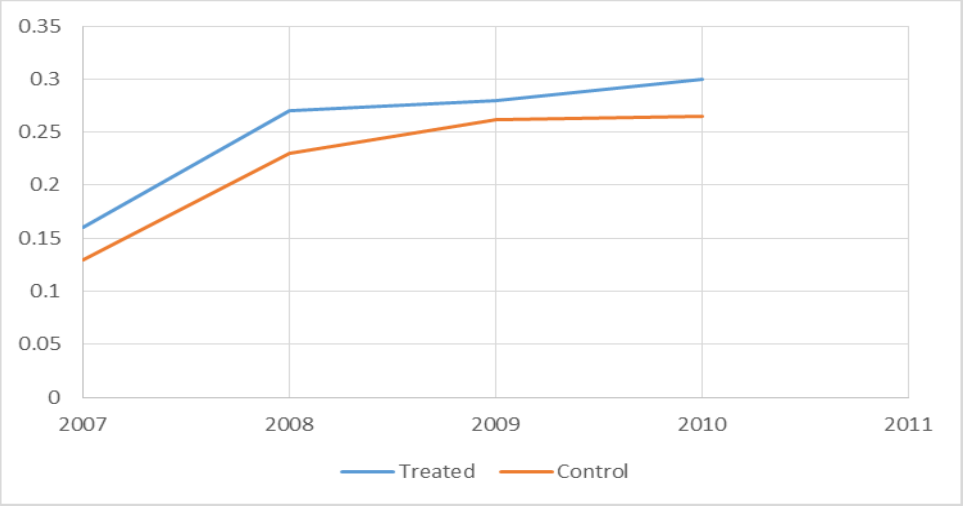


Figure 4-3 **Parallel path 2007–2011 (education spending per capita)**

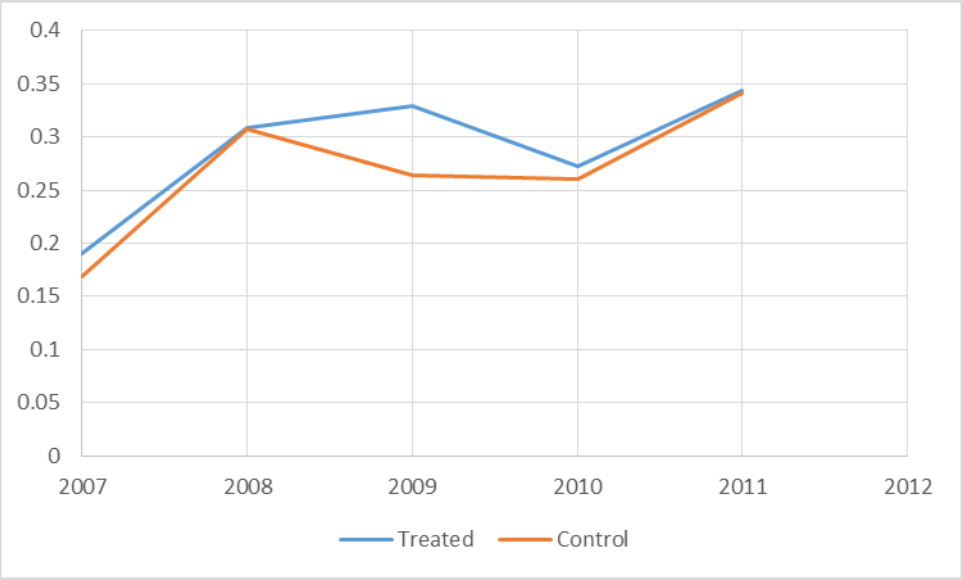
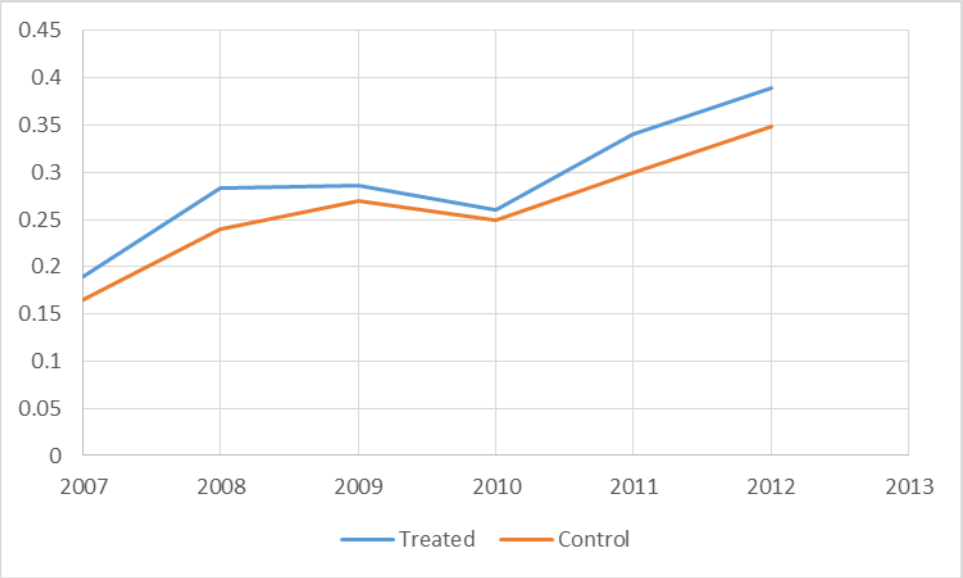


Figure 4-4 **Parallel path 2007–2012 (Education spending per capita)**



After deriving a control group for each period of study, the analysis begins to investigate the impact of RIF on education spending for the three periods. Because the allocation of RIF is on an annual basis, DiD application is more suitable to estimate whether there are differences on outcomes in the following year. The allocation of RIF is based on certain formula, where districts will receive the allocation after scoring highly on predetermined indicators. Hence, the composition of recipient districts

changes every year, although some districts consistently receive the RIF allocation when they manage to maintain the highest composite score. RIF is announced in the previous year (*t*–1), and is disbursed next year (*t)*. To ensure the accuracy of DiD estimation, the participants in the program evaluated need to be consistent. Hence, this study uses 2009 as the base year, when the RIF program was absent. This study splits the analysis into three periods, 2009–2010, 2009–2011 and 2009–2012.

The benefit of DiD is that the model can control unobserved time-invariant variables which may lead to biased results which are present in before-after estimators by sweeping out time-invariant effects on dependent variables. DiD assumes this unobserved heterogeneity is time invariant, so the bias cancels out through a fixed effect approach. The fixed-effects estimation is applied to see whether RFI allocation affects education spending in recipient districts. Each entity has its own time constant individual unobserved characteristics or heterogeneity that may affect the investigated variable. The existence of unobserved heterogeneity, including area size and district geography, may correlate with other control variables, intergovernmental fiscal transfers, leading to omitted variables when the regression model does not take it into account, and making the estimators biased and inconsistent. Following the requirements attached to the use of RIF, this study attempts to estimate the impact of RIF on education spending. The estimation model is as follows:

$$y_{it} = a + \beta_1 T_i t + \beta_2 T_i + \beta_3 t_i + \beta_4 u_i + \beta_5 \mathbf{X}_{it} + \varepsilon_{it} \qquad (1)$$

The dependent variable is education spending. T_i is a dummy variable for treated districts with a value of 1 for RIF recipients and 0 for non-RIF recipients. The use of the RIF recipient dummy aims to find out whether those districts holding the status of RIF recipients have greater education spending than non-RIF recipients. In this way, I can capture the extent to which education spending is incremented in RIF recipients. The

increments show whether RIF recipients use all of the RIF they receive for education spending, otherwise fund fungibility is indicated. t_t represents time dummies for the base year and treatment year with the value of 0 and 1 respectively, and $T_i t$ is the interaction between time and the treatment dummy, which is the main variable of interest. This interaction estimates whether districts receiving RIF have greater increases in education spending. u_i represents the time-invariant variables of each district. The vector of **X** is the relevant strictly exogenous explanatory variable used to estimate the effect of RFI on education spending. These variables include total fiscal transfer (excluding RIF), percentage of people living in urban areas, percentage of people of active age, population and GRDP per capita. ε_{it} is an error term where Cov (ε_{it} , T_{it}) = 0.

The average real RIF allocation is around 5% of total education spending or around 9 billion IDR for the three years of the allocation period, which is small compared to RIF recipients' average education spending, which accounted for 144 billion IDR. For the period 2009 to 2012, the average education spending in recipient districts was almost 400.000 IDR per capita and the average RIF allocation was around 39.000 IDR per capita. Hence, it was expected that recipient local governments would increase their education spending by at least 39.000 IDR per capita if the transfers were fully used.

Column 1 in Table 4-7 shows the baseline estimation of RIF impact on education spending for the period 2009 to 2012. The fixed effect estimation with dummy variables, where 1 is a district receiving RIF and 0 a non-RIF recipient, shows positive significant effects on education spending when a district is an RIF recipient. On average, RIF recipient districts spend 76.000 IDR per capita more on education than non-RIF recipients. This figure suggests that all RIF allocation is fully spent on education spending. The dummy island shows that districts in Java and Bali and Sumatera have higher education spending per capita compared to other islands.

When the treatment assignment is not random, the use of a dummy variable for treatment assignment leads to selection bias because of the following factors: (a) purposive program placement, and (b) self-selection into the program (Khandker et al. 2012). In this case, the RIF allocation is explicitly aimed to target local governments with better performance. Besides, the main interest of this study is to examine whether the increase in education spending in RIF recipients is due to RIF allocation rather than other factors. The difference in difference estimation attempts to ensure that the increase in education spending is due to the presence of RIF.

The difference in difference approach estimation results are displayed in columns 2 to 10 in Table 4-7. These represent the before and after mean change in education spending in RIF recipients over the before and after mean change in the non-RIF recipients. The use of the treatment dummy implies the impact of participation in the RIF program on education spending.

Columns 2, 5 and 8 show the most parsimonious specification, including only district dummies, year effects and interactive variables of recipient districts and treated years. This model indicates an increase in education spending among RIF recipient districts for the years 2010 and 2011, but not for 2012. Given the variable of interest is an interactive dummy variable, the point estimate of 0.111 suggests that compared to education spending in 2009, in 2010 RIF recipient districts increased their education spending by 111.000 IDR more than non-RIF recipients. It should be noted that the treatment effect is a dummy variable suggesting the expenditure size per capita of RIF recipient in treatment year. Hence, this coefficient suggests an increment in education spending in RIF recipient districts in 2009 and 2010. The difference in difference estimations show strong and positive increases in education spending for the period 2009–2011, but statistically insignificant increases for the period 2009–2012. Although

the estimations suggest positive results, this specification is not appropriate since they do not control the other covariates which determine education spending.

To compare the sensitivity of the effect with regard to control group selection, I test the difference in difference estimation with matching and non-matching. Columns 3, 6 and 9 in Table 4-7 employ additional covariates which explain the education spending and use all non-RIF recipients as a control group. The difference in difference estimation without matching shows consistently significantly greater education spending in RIF recipients compared to the previous dummy only estimations. The effect of the regional incentive fund on education expenditure in RIF recipients is statistically positive and significant for all periods of analysis. The magnitude is slightly smaller, which results from the additional covariates. The non-matching double difference estimation shows the RIF recipients allocated 82.000 IDR of education spending per capita more than non-RIF recipients in 2010 compared to 2009. The increment of education spending in 2012 compared to 2009 is also greater in RIF recipients compared to non-RIF recipients, but the increment size is smaller, accounting for only 30.000 IDR per capita.

Total fiscal transfers in general play a crucial role in determining the size of education spending, as expected. Other demographic variables and the working age population do not become significant factors in determining the size of education spending. Only the percentage of people in urban areas, representing the urban characteristic, becomes an important factor in determining education spending. One plausible reason is that the provision of education services supports the business sector.

The double difference estimations with matching in columns 4, 7 and 10 confirm the previous models, i.e. that RIF allocation encourages recipient districts to increase their education spending, on average by 77.000 IDR per capita greater than non-recipient districts in 2010 compared to 2009. In other words, the increase in education spending

in RIF recipient districts from 2009 to 2010 was greater than in non-RIF recipient districts and statistically significant. Given the average RIF allocation, accounting for 32.000 IDR per capita in RIF recipients in 2010, almost 45.000 IDR per capita comes from districts' own budget.

Compared to education spending in 2009, RIF recipients increased their education spending by 58.000 IDR per capita in 2011. This impact was slightly lower compared to RIF recipients' education spending in 2010. With the average RIF allocation accounting for 27.000 IDR per capita in 2011, this increase suggests that around 31.000 IDR per capita of increased education spending came from RIF recipients' own budgets. The lower role of RIF recipients' budgets in education spending can also be seen in 2012. Although RIF recipients increased their education spending, the increase in 2012 was much smaller than in previous years. With 26.000 IDR per capita in RIF allocation, on average local budgets only contributed 5.000 IDR per capita toward the 31.000 IDR per capita increase in education spending. Alternatively, these estimations can be interpreted to say that the difference in the increase in education spending was getting smaller in subsequent periods of RIF allocation.

To ensure the robustness of these results, I estimate the impact of RIF based on the characteristics of local governments, which may influence their policies around using the RIF. I use the classification of mineral and non-mineral-producing districts where shared natural resource revenue serves as one component of fiscal capacity. The mineral-producing districts have greater fiscal capacity due to their shared natural resource revenue. The RIF recipients with greater fiscal capacity will not rely on RIF for their education spending. Hence, whether these characteristics affect the dissipating size of education spending can contribute further to understanding the dynamics of RIF

in recipient districts. The minerals classification includes oil, geothermal, coal and other type of extractive commodities.

Table 4-7 **DiD Estimation results: education spending**

Variables	2009–2012	2009–2010			2009–2011			2009–2012		
	Pooled panel data	DiD-No covariates	DiD-Non Matching	DiD With matching	DiD-No covariates	DiD-Non Matching	DiD With matching	DiD-No covariates	DiD-Non Matching	DiD With matching
	1	2	3	4	5	6	7	8	9	10
Treatment effect (RIF*treatment year)	n.a	0.111*** (0.038)	0.082*** (0.020)	0.077*** (0.019)	0.079*** (0.042)	0.064** (0.032)	0.058** (0.032)	0.041 (0.033)	0.030* (0.002)	0.031*** (0.011)
Total transfer	0.046* (0.024)	n.a	0.048 (0.045)	0.040 (0.036)	n.a	0.085 (0.065)	0.081 (0.063)	n.a	0.040 0.031	0.120*** (0.023)
GRDP per capita	5.45e-10 (3.43e-09)	n.a	–0.007 0.0111627	–0.007 (0.005)	n.a	–0.004 (0.005)	0.007** (0.003)	n.a	–0.0005 0.003	–0.001 (0.002)
Population	–1.37e-07 (9.72e-083)	n.a	–1.61e-07 (1.12e-07)	–2.00e-08 (4.33e-08)	n.a	–2.42e-08 (9.83e-08)	4.43e-08 (8.41e-08)	n.a	–9.81e-08 (8.13e-08)	–1.27e-08 (8.07e-08)
People in urban area (%)	0.0008 (0.0009)	n.a	0.0004 (0.0007)	0.001 (0.0008)	n.a	0.002** (0.0009)	0.003** (0.001)	n.a	–0.035 (0.083)	0.0002 (0.0004)
People age 15–64(%)	0.0007 (0.0006)	n.a	–0.00006 (0.00005)	–0.00009 (0.00006)	n.a	0.065 (0 054)	0.065 (0.054)	n.a	0.0006 (0.0005)	–0.00002 (0.00002)
RIF Recipient	0.076*** .012	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Java and Bali	0.086** (0.039)									
Sumatera	0.022* (0.12)									
Papua	0.086 (0.068)									
Sulawesi	-0.034 (0.028)									
R2 (within)	0.22	0.01	0.16	0.19	0.007	0.31	0.31	0.005	0.33	0.35
Observation	1864	943	896	768	939	922	885	958	928	815
Number of group	485	484	484	406	485	484	456	484	484	423

Note: All fiscal and economic variables are measured in constant (year 2000) per capita terms and written in million IDR for the convenience of reading. The year variable is controlled for full panel estimation. The time and treatment dummy are not displayed. The t-statistic is based on robust standard errors. ***,** and * show statistical significance at 1%, 5% and 10% levels of significance respectively.

Table 4-8 shows the results of DiD estimation with matched control groups from their own group of mineral or non-mineral-producing districts

Table 4-8 **DiD estimation based on natural resource wealth**

Variables	2009–2010		2009–2011		2009–2012	
Education spending (Dependent variable)	Mineral-producing districts	Non Mineral-producing districts	Mineral-producing districts	Non Mineral-producing districts	Mineral-producing districts	Non Mineral-producing districts
Treatment effect (RIF * treatment year)	0.035 (0.030)	0.088*** (.027)	0.058** (0.029)	0.076* (.045)	0.024* (0.015)	0.033** (0.034)
Total transfer	0.210*** (0.041)	0.006 (0.005)	0.140*** (0.024)	0.049 (0.051)	0.113** (0.013)	0.005 (0.005)
GRDP per capita	–0.16* 0.009	0.066 (0.025)	–0.005 (0.004)	0.062 (0.063)	–0.001 (0.002)	0.044 (0.030)
Population	–1.51e-08 9.54e-08	–2.01e-08 7.54e-08	6.86e-09 9.76e-08	2.35e-07 2.87e-07	–7.34e-08 6.17e-08	5.56e-08 1.70e-07
People in urban area (%)	–0.0006 (0.0008)	0.0008 (0.0006)	0.002** (0.0008)	0.002* (0.001)	0.127* (0.071)	–0.051 0.114
People age 15–64(%)	–0.00003 (0.00007)	–0.00004 (0.00005)	–0.002 (0.014)	0.070 (0.057)	0.007 (0.005)	0.072 0.057
R2 (within)	0.42	0.23	0.38	0.34	0.38	0.36
Observation	537	359	555	377	560	368
Number of group	294	188	294	194	294	190

Note: All fiscal and economic variable are measured in constant (year 2000) and per capita terms, converted using the implicit GDP deflator from Indonesia's national accounts. The t-statistic is based on robust standard errors.

The overall result is that the RIF recipients' greater education spending had mixed significance. Although the trend over the three years of the analysis period shows declining size of the increment in education spending, the size is greater in non-mineral-producing districts. Further, fiscal transfers play a more important role in determining education spending in mineral-producing districts, but not in non-mineral-producing districts. The urban characteristic also plays an important role, but the roles of other variables are muted. Overall, the estimation based on districts' characteristics demonstrates similar results, that is, the impact of RIF on education spending is dissipating regardless of fiscal capacity.

4.5.3 Sensitivity analysis

Ensuring the robustness of DiD results above, a different time specification is applied. Instead of using 2009 as the base year, the next estimation uses the previous year of treatment as the base year. Hence, the periods of analysis are 2010–2011 and 2011–2012. As before, the PSM method is used to derive matched non-RIF recipient districts for both periods. To ensure the treated and control groups have similar characteristics and conditions in the base year, the estimations for 2010–2011 only use treated districts which received RIF in 2011 and exclude districts which received RIF in 2010 or both years. Non-treated districts which received RIF in 2010 are also excluded. The same approach also applies for the period 2011–2012. The balancing property for the two periods of time is shown in Tables 4-9 and 4-10.

Table 4-9 **Propensity score balancing property 2010–2011**

Block	Group	Observation	Mean	t-test
1	Control	275	0.083 (0.002)	
	Treated	26	0.091 (0.006)	t = –1.2330
2	Control	0	n.a	n.a
	Treated	1	n.a	n.a
Total	Control	275		
	Treated	21		

Table 4-10 **Propensity score balancing property 2011–2012**

Block	Group	Observation	Mean	t-test
1	Control	289	0.105 (0.001)	
	Treated	40	0.107 (0.004)	t = –0.4064
2	Control	2	n.a	n.a
	Treated	1	n.a	n.a
Total	Control	291		
	Treated	41		

Although the treated districts are reduced, the fixed effect estimation for the pooled period of 2010 to 2012 in column 1 of Table 4-11 shows greater education spending in RIF recipients. Columns 2 and 4 show the double difference estimation with dummy variables only. There is no significant difference in education spending in RIF recipients. The estimations with additional covariates and previous years as base years show a generally positive impact of RIF allocation on education spending in recipient districts, but insignificant for the period 2011–2012 as shown in column 5 in Table 4-11. The RIF allocation induced recipient districts to increase their education spending by 56.000 IDR per capita from 2010 to 2011, although at a 10% level of significance. The estimations with previous years as baseline also show a positive effect of RIF allocation on education spending in RIF recipients. A previous study with yearly analysis also finds declining impact of federal transfers on education spending (Gordon 2004).

Table 4-11 **DiD Estimation results-2010–2011 and 2011–2012**

Variables	Full panel data (2010 to 2012)	2010–2011		2011–2012	
		DiD-No covariates	DiD-with covariates	DiD-No covariates	DiD-with covariates
	1	2	3	4	5
Treatment effect (RIF * treatment year)	n.a	0.024 (0.038)	0.056* (0.033)	0.005 (0.034)	0.027 (0.042)
Total transfer	0.025 (0.023)	n.a	0.059 (0.062)	n.a	0.143 (0.111)
GRDP per capita	0.006*** (0.002)	n.a	0.003 (0.003)	n.a	0.009 (0.013)
Population	–1.01e-06*** (2.83e-07)	n.a	–8.23e-07 (5.39e-07)	n.a	1.60e-07 (3.28e-07)
People in urban area (%)	0.098** (0.031)	n.a	–0.102 (0.222)	n.a	–0.161. (0.310)
People age 15–64(%)	0.00005 (0.0004)	n.a	–0.005 (0.006)	n.a	0.001 (0.001)
RIF Recipient	0.022*** (0.010)	n.a	n.a	n.a	n.a
R2 (within)	0.06	0.03	0.14	0.007	0.01
Observation	1418	848	641	829	514
Number of group	485	439	333	445	263

Note: All fiscal and economic variables are measured in constant (year 2000) and per capita terms, converted using the implicit GDP deflator from Indonesia's national accounts. The t-statistic is based on robust standard errors.

4.6 Discussion

The plausible argument of the positive impact of RIF on education spending is that the conditionality, the legal restrictions on the use of the fund, has ensured recipients use the fund for education spending. The fund's feature giving discretion to recipients on the programs implemented in the education sector appears to contribute to achieving the objective of the fund. However, the magnitude of effect is diminishing over subsequent years. Although the recipients used up all the RIF in each allocation year, the dissipating increment of education spending in RIF recipients provides evidence of displacement of education spending to other functions, known as non-additionality fungibility. Following Shah (2007) and World Bank (1998) we find that smaller sizes of RIF allocation compared to recipients' education spending contribute to potential fungibility in recipients' education spending. Because the recipients have already

allocated education spending as the greatest portion of their budget, the effect of RIF is insignificant in enlarging their education spending. Hence, they divert their own resources for education spending to other spending and substitute with RIF. Besides, the lack of monitoring of education spending has weakened expected benefits. Although internal audits have been carried out to verify whether RIF recipients have used the fund as required, information on the overall impact on education spending is absent. This suggests that a mechanism for monitoring the targeted output should be in place to ensure the RIF is not treated as substitute resource for education spending. An alternative approach is to link output performance with payments, known as output-based conditionality (Shah 2007).

4.6.1 Output-based transfer

The rationale of output-based transfers is to provide incentives to subnational governments to improve their performance by linking their access to grants and/or the amount disbursed to delivery performance in predetermined areas (UNCDF 2010). This transfer still imposes conditionalities, including the type of expenditure that can be financed, on the results to be achieved while providing full flexibility in the design of programs. Hence, the crux of output-based grants is to promote positive change in aspects of the performance of local governments by conditioning access to grants on the achievement of certain desirable goals. By linking transfers with specified outputs or results, this model can improve result accountability, which is commonly weak at local government level. Previous studies in the literature also advocate output-based systems as a way to increase accountability, efficiency, quality and equity of service delivery (Eldridge & Palmer 2009).

Many countries have embedded fiscal incentives in intergovernmental fiscal transfers to stimulate local governments to achieve specific targets, and in many cases they must meet requirements to get access to the transfer. Although the features of performance-based transfer can take many innovative designs, the basic principle is that there needs to be a match between funding and predetermined outputs. The discussion below draws heavily from UNCDF (2012).

Subnational governments need to show that their performance complies with certain criteria to access grants. International experience uses two indicators for transfer access. Firstly, minimum conditions, which serve as the basic conditions which must be met for transfer access or eligibility. Secondly, performance measures which serve as the trigger for payment when local governments meet pre-specified measures.

The design of output-based transfers varies in many countries and is flexible toward the situation in each country. The Danish system of local government features a reimbursement scheme in which the percentage reimbursed depends on the extent to which local government spending is consistent with specific policy aims. In Japan, for example, road grants come with certain minimum standards, such as the number of lanes that must be built.

The principle of output-based transfer can be used with RIF to promote education spending. The existing conditionality, use restricted to education functions but with discretion over programs, can be continued and equipped with additional specific performance measurements. One approach to measure education expenditure performance uses the percentage of RIF over education spending in the year of RIF allocation. The percentage of RIF over education spending in the RIF allocation year

must not be bigger than the percentage of RIF in a certain allocation year over its previous year's education spending.[31] The education spending must exclude RIF to avoid double counting. Payment can be done in two tranches. The second payment can be made when the evaluation of the first tranche shows a satisfactory result.

4.7 Conclusion and policy implications

This paper studies the impact of earmarked fiscal transfers in Indonesia, the regional incentive fund, on recipients' education spending. The empirical estimation is carried out through combining a difference in difference approach with propensity score matching on RIF eligibility variables. The main finding of this study is that the RIF does induce recipient local governments to increase their education spending. There is evidence that the conditionality embedded in the fund, which legally requires recipients to use the fund for education functions only, has ensured the recipients use the fund as intended. However, the estimations show declining size in the increment of education spending. The increase in education spending is greater only in the first year of RIF allocation, but is smaller in the subsequent years of allocation. This diminishing increment in education spending provides evidence of the potential presence of non-additionality fungibility in RIF. Although the RIF grants were fully used for the education function, recipients substituted their own resources for education spending with the money they received from RIF. Therefore, the RIF contributes more to the increment in education spending than the recipients' own budgets. The absence of a mechanism to monitor recipients' education spending appears to contribute to the weakening effect of the RIF.

[31] The increase in education spending in RIF allocation year compared to previous year's education spending makes the ratio of RIF over education spending smaller in RIF allocation years than in previous years.

This finding suggests the need to redesign the conditionalities embedded in this fund. As an alternative design, the literature suggests an output-based approach which links post intervention indicators with the fund's objective. The link between transfer payments with certain output measures is a key feature driving greater accountability in the use of grant monies. The existing conditionality can be equipped with impact monitoring through measuring performance in education spending. The alternative measurement is the use of the percentage of RIF over education spending in the allocation year, which must not be greater than the percentage in previous years. Because the nature of RIF allocation is to top up recipients' education expenditure, the central government can monitor the impact of the use of the fund on recipients' education spending.

5. Conclusion

This thesis has investigated three aspects of fiscal policies. The first study investigated the impact of shared-mining revenue on own-source revenue in mineral-producing districts. The second study examined spatial interaction in environmental spending and potential channels of pollution spillover. The third study evaluated the impact of regional incentive funding on recipients' education spending.

Countries with natural resource endowments are facing greater challenges in ensuring the benefits of the natural resources increase their citizens' prosperity. The multi-dimensional aspects of natural resource management, from wealth distribution to environmental management, require sound policies and quality institutions. Many studies in the literature have suggested fiscal decentralization as an important policy to achieve better natural resource management.

Indonesia adopted fiscal decentralization in 2001 and accompanied it with environmental policy decentralization. Nevertheless, concern about sub-standard fiscal management in many local governments has emerged, and environmental degradation has increased demand to revamp environmental policies. This thesis has studied the fiscal performance of natural resource producing districts in Indonesia. The study has resulted in some important findings and contributions to the literature. The thesis also provides insights about the design of fiscal transfers to promote environmental spending in districts.

The first study argues that under the shared natural resource revenue system, mineral-producing districts do not have control over revenue collection for their natural resource endowment. Hence, they cannot substitute own-source revenue with natural

resource revenue. This study constructed a dataset of479 districts, with particular focus on 302 mineral-producing districts, for the period 2001–2012. The fixed effect estimations provide evidence that shared-mining revenue is not associated with lower own-source revenue in mineral-producing districts. This is a different situation to that which is commonly found at national level. Because of the ability to substitute between tax revenue and natural resource revenue, national governments have the opportunity to substitute revenue sources and prefer to mobilize greater natural resource revenue and neglect tax revenue.

This study also provides evidence of a negative correlation between the poverty rate and retribution revenue in mineral-producing districts. It suggests that the higher poverty rate in mineral-resource producing districts has contributed to the lower own-source revenue. The literature has pointed out that higher poverty rates suggest weak institutions in natural-resource wealth jurisdictions. This demands more stringent supervision on mining practice to ensure a more sustainable extractive sector in mineral-producing districts in Indonesia.

This study contributes to the literature on fiscal policies in natural resource wealth jurisdictions by giving a different perspective about the interaction between natural resources and revenue efforts at local government level. The findings give insights to Indonesian policy makers on policies to promote greater own-source revenue in mineral-producing districts. Specifically, the findings suggest implementation of more vigorous policies to ensure optimal benefits of resource revenue to reduce poverty.

The second study in this thesis analyzed environmental spending, including environmental and forestry functions, in physically neighbouring districts in Sumatera

and Kalimantan Island. Using district level data for the period of 2009–2012, the spatial econometric estimations find strong evidence of positive spatial interaction through spending spillover among local governments in these islands. The positive correlation suggests that a district will increase its own environmental spending when its neighbours increase their environmental spending. This study argues the pollution spillover from districts hosting polluting sectors, in this case mineral and timber producing districts, imposes environmental costs in neighbouring districts. Hence, districts affected by pollution spillover will have to increase their environmental spending to mitigate the impacts. This study uses shared natural resource revenue as a proxy for pollution spillover and finds a positive association between shared natural resource revenue in mineral-producing districts and neighbours' health spending, suggesting the natural resource sector in mineral-producing districts has imposed environmental costs on neighbours. This study also finds a lack of environmental spending, in per capita terms, among mineral-producing districts in Sumatera and Kalimantan Island. The average environmental spending in mineral-producing districts is not significantly different that of from non-mineral-producing districts.

For policy implications, this finding attempts to draw attention from stakeholders and policy makers in Indonesia, in particular in the environmental policy area. The lack of environmental spending in mineral-producing districts will bring greater consequences to human life and Indonesia's commitment to reduce greenhouse gas emissions. Central government needs to encourage local governments to mitigate environmental consequences due to natural resource exploitation, through greater environmental spending in their jurisdiction. The provision of environmental fiscal transfers to local governments can be a viable option.

This is the first study to investigate the spatial interaction of environmental spending in Indonesia. Although the negative effect from fiscal externality is acknowledged in the literature, this issue is still under-explored. This study also contributes to the literature on environmental policies by shedding light on the mechanism of positive spatial correlation in the environmental spending.

The third study assesses what the central government can do, using the fiscal transfer system, to help achieve desirable outcomes in resource-rich districts. There is no targeted fiscal transfer system in place to address environmental spending in mineral-producing districts, but the fiscal transfer system could potentially be used for this. In order to assess the prospects of such a mechanism, this study evaluates the existing fiscal incentive which provides fiscal transfers earmarked for education spending. The third study in this thesis provides insights into the design of fiscal transfer through examining the impact of the regional incentive fund (RIF) on recipients' education spending.

This study uses a difference in difference approach combined with propensity score matching with three periods of analysis, 2009–2010, 2009–2011 and 2009–2012. The main finding of this study is that the RIF does induce recipient local governments to increase their education spending in recipient districts. This finding suggests that the conditionalities imposed on RIF, legally restricting the use of the funds to education functions, have ensured the recipients use the funds as intended. However, the magnitude of impact is diminishing over subsequent years of the allocation of regional incentive fund. This raises concerns about non-additionality fungibility in education spending, where the recipients substitute their budget for education spending with the

money they receive from the regional incentive fund. The absence of any mechanism to assess recipients' performance in education spending apparently weakens the benefit of this fund.

In addition to being the first study undertaken to analyze the central government's existing fiscal incentive, the findings of this study provide both an analytical evaluation of RIF and an insight into the design of fiscal incentives for environmental policies. A mechanism for monitoring the performance in education spending of RIF recipients is needed to ensure optimum benefits for local citizens. The literature suggests the use of output-based transfers, which link certain education spending performance with disbursement of funds. Through this approach, central government can ensure the impact of fiscal transfers on targeted spending.

The findings of this thesis highlight the interaction between natural resource endowment and fiscal policies at sub-national level in Indonesia. There are three points can be drawn from this thesis. Firstly, the low own-source revenue suggests greater reliance on fiscal transfers among mineral-producing districts in Indonesia to manage challenges in the natural resource sector, including environmental impacts from natural resource exploitation. There appears to be a need for central government intervention to promote greater efforts in own-source revenue mobilization. Secondly, the lack of environmental spending in resource-rich districts can result in further environmental degradation. One approach central government can take is to promote greater environmental spending through the provision of environmental fiscal incentives. Thirdly, with regard to fiscal incentives, central government needs to impose conditionality, where local governments agree to not substitute their environmental

spending with respect to environmental fiscal transfers. Central government can use conditional output-based transfers to monitor agreements by linking certain measurement in environmental spending with transfer disbursement.

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